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February, 1932

Gambling in Research

RESEARCH, as one distinguished commentator has recently pointed out, contains a certain element of speculation closely akin to gambling. In recent years, the frenzied search for new ways of cornering the elusive profit has tempted more than one manufacturer to overlook the sound, rational motive of research and instead plunge recklessly into a program far beyond his capacity to develop and maintain. The result must inevitably be a setback for the science and the technical men who have allowed themselves to be carried away by the gambler's desire for quick profits.

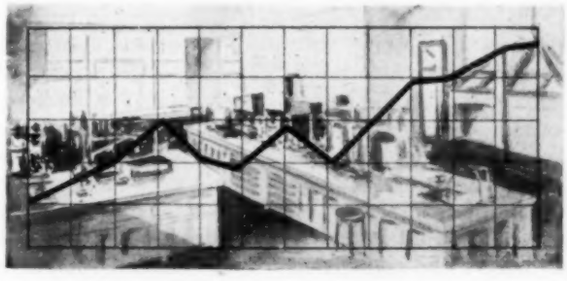
IF RESEARCH is to be a gamble, then those who play the game should know the odds it offers for success or failure. Fortunately, information on this score has lately become available from several sources of unquestioned authority and experience. Dr. Lawrence V. Redman, in accepting the Grasselli Medal for 1931, warned against the enthusiasm of the research proponent "who would have his associates risk a fortune on a test-tube experiment, or the scarcely less foolhardy who would plunge into advertising on the appearance of the first one hundred pounds successfully made." Not only must there be a large outlay in money and effort but Dr. Redman's experience suggests that usually there is a period of seven or eight years between the start of a research project and the full liquidation of the investment.

MUCH the same philosophy underlies the brilliant record of twenty years of successful research for which the 1931 impression of the Perkin Medal was awarded to Dr. Charles F. Burgess. His address, "Research—For Pleasure or for Gold," well summarized the vital statistics of research in this paragraph:

> When a man with the prospectus of a new device or product or process presents himself. . . . . I have to tell him that to put it through the laboratory course may involve a cost of $1,000, perhaps $100,000. Our average for all projects has been $7,000. I must tell him that no matter how practical the idea he presents may seem to him or to us, there is but one chance in five that it will pass successfully through the laboratory stages; furthermore, that the investigation, if it survives the full course, may take anywhere from a year to fifteen years, with the probability of seven as an average. It is with these figures in mind that we appraise any new proposal for a research project.

WITH such figures in mind, the technical man can also help to take much of the gambling out of research. He can encourage, if not insist upon, the long-time viewpoint that will insure continued support to a program in the face of early failure and difficult times. He can likewise apply the brakes when, through somebody's overenthusiasm, more projects are launched than can ever be carried through to successful completion.

RESEARCH is more important today than ever before. Progress is bound to be made whenever it is conscientiously applied. But for the ultimate good of those who make it effective—as well as those who profit from its effectiveness—research must be set up as a stable investment and administered by business men who know research, or by research men equipped to share in the affairs of business.



EDITORIALS

FEBRUARY, 1932

What Industry Stands to Gain

NEW MONEY is most needed in process industries for two purposes: (1) the replacement of obsolete equipment in order to effect desirable and necessary economies; (2) the launching on a commercial scale of new projects for which the research and development work is already completed. In more normal times a bond issue or other expansion of capital structure would readily provide the funds. For the past two years, however, that avenue has been blocked, and what industry has spent for capital investments has had to come from earnings or accumulated surplus. The banker has been absorbed in his own fight for his very existence and has mustered to his defense every available resource, even to the extent of crippling those he should help. Now comes the Reconstruction Finance Corporation to strengthen his position, to dissipate the fears of his depositors and thus to provide a sounder basis for his normal relations with industry.

The government has apparently gone the limit to create confidence in the banks; it is now up to the latter to make money and credit easier to get. The new agency will, in itself, provide no funds for process industry needs, but it should pave the way for the return of the investor's confidence in the real values that will come from capitalizing immediately on the products of research and improved processes and equipment.

In the meantime, what can executives of process industries do to speed this restoration of credit? First, they can ascertain the facts in their local communities, and then, working with their own employees and associates, start in immediately to rebuild confidence in the soundness of their local institutions. They can and should aid in the community drives against hoarding and other short-sighted practices engendered by unreasoning fear. The individuals and industries that share in this important work of reconstruction are sure to gain in the process. After all, credit is often a local and personal issue, and there is no better security than demonstrated ability and leadership.

Patent Law Recommendations Requested by Congress

PATENT problems of all types are now being discussed before the House of Representatives committee headed by Dr. Sirovich. As announced by the chairman, the committee wishes to consider even the most fundamental characteristics of the present patent law in order to draft a comprehensive measure to correct deficiency or defects. Representatives of the patent bar, of the various engineering professions, and of all branches of industry are invited to appear before the committee and explain the problems which their experience has disclosed and recommend means for legislative remedy.

The Manufacturing Chemists' Association and the Synthetic Organic Chemical Manufacturers' Association have already arranged to work jointly and present their recommendations through Warren N. Watson, secretary of the former. On behalf of the associations, Mr. Watson requested opportunity to make an extended investigation with report and recommendations in the autumn, but the committee does not wish so to extend its inquiry and has requested that all recommendations and appearances before the committee be made during February.

It will not be necessary for all those who desire to make recommendations to appear personally before the committee. They may send their communications through Mr. Watson's office. Or they may communicate by letter to the committee chairman, with every assurance that their suggestions will have careful consideration.

When all of the recommendations which can be made available this month are in hand it is proposed that an extended study be made by a drafting sub-committee and that the bills which result be then subject to further public hearings. Chemical executives should avail themselves fully of the opportunity both now and on that later occasion to express the needs of their divisions of industry to this important congressional group.

Employment for The Unemployed

EACH DAY finds new faces among the unemployed chemists and chemical engineers, and each day witnesses an increase in the size of the army of unemployed. Of even more serious consequence is the ever growing number of cases in dire need and distress. Unfortunately there is still some tendency on the part of those in responsible positions to minimize the seriousness of this situation. Not only do they underestimate the number but also the calibre of the men out of work.

The situation in the New York metropolitan area is particularly serious. Over 300 men and women have registered with the Committee on Unemployment and Relief for Chemists and Chemical Engineers. Of this number, 70 have signified that their resources have been exhausted and that they are now in need of immediate relief. An analysis of the cases in extreme circumstances shows that 80 per cent are college graduates and 30 per cent have had graduate training. Further, it discloses that 13 per cent, when last employed, received salaries of over $5,000 and 57 per cent over $3,600. Moreover, it has been the experience of this committee that many of the men formerly in higher salaried positions are reluctant to register for fear of jeopardizing their future position in the industry.

This New York committee, which is sponsored by the local sections of the several chemical societies, is one of the most active organizations of its kind in the country. It is engaged in registering the unemployed and in securing positions for them. In the few weeks that it has been operating, employment has been found for 25 men and women with technical training. And this figure probably would have been larger had the committee not been handicapped on several occasions by lack of registrants possessing the required qualifications.

The unemployment problem demands the attention and consideration of all in a position to help in its correction. The chemical industries owe it to themselves and their

former employees to assist relief committees in looking after the welfare of these men. They can assist by reporting promptly to the committees any vacancies in their own organizations or the names of firms that might be in a position to use the services of additional men. Work along chemical lines is, of course, preferable; however, jobs of any kind will be welcome. The technical societies must continue to make it their most important duty to assist members and former members who are in actual need.

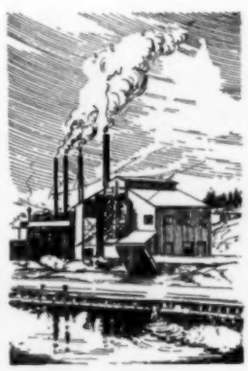
Wisconsin Takes the Lead For Unemployment Compensation

WISCONSIN has taken the initiative in forcing industry to assume responsibility for providing either steady work or unemployment compensation for its personnel. The plan will become effective and will be made compulsory for all employers of ten or more persons who have not made provisions for unemployment reserves by June 1, 1933, unless by that time, a majority of the eligible employees of the state are protected by a privately sponsored unemployment reserve plan. Some form of guarantee to the workingman of a means of livelihood at all times is beginning to be recognized as an industrial obligation. And society has been waiting to ascertain whether employers will solve their unemployment problems voluntarily if given a chance. The Wisconsin plan, sponsored by Governor LaFollette, offers this opportunity to industry but places a time limit upon the voluntary action. The state has provided for failure by holding out the threat of a plan of its own making.

Leaders in the other states should take a warning from the action of Wisconsin. They should realize that bills put through other state legislatures, especially in times of duress, may be far more severe and exacting upon employers and that the best means of forestalling these measures is the operation of a privately financed plan of their own development.

The Census of Manufactures Deserves Your Cooperation

WITHIN the fortnight the Bureau of the Census has released the results of the first of a series of studies of the thirty-three most important industrial areas of the United States. Now, for the first time, statistics of production, wages and payrolls, materials and power consumed are available for "Industrial New York City," defined to include the six counties in New York and six in New Jersey in which manufacturing activity centers around the Manhattan metropolis. This breaking down of state lines in order to represent more logically the actual centers of trade is but another step in the government's effort to make its figures serve the exacting requirements of industry.



Just at this time, when we are receiving the final compilations and analyses of the census made in 1930, the Bureau is mailing its 1932 batch of questionnaires to all manufacturers. With them goes the urgent request that they be filled out completely and returned promptly. This, it would seem, is the least that industry can do in return for the values that will accrue from wholehearted cooperation.

This year's questionnaires are considerably smaller than the ones used in the preceding census, which was one of the decennial series. Every ten years the schedules are expanded to include a great deal of detailed information normally omitted from the biennial series. However, in addition to the production figures of most importance, the present questionnaires include for chemical industry certain special inquiries in regard to materials consumed and machinery and equipment in use. The data so obtained form the basis of market studies and commercial research that have been so helpful in recent years. Thus it is to the self-interest of industry to cooperate with the Census Bureau to the end that its questions will be answered accurately, completely, and with sufficient dispatch to insure the release of information in time to be of maximum usefulness.

A Rest From Fruitful Labors

WHEN Charles H. MacDowell announced late in January, the relinquishment of his duties as president of the Armour Fertilizer Works, an epoch in the history not only of a company but really of an entire industry had been marked off—an epoch which saw meat packers emancipated from costly wastes; an epoch of byproduct utilization expanded to the scale of completely new industries.

In this transformation Mr. MacDowell played an almost vital part, cultivating these responsibilities for Armour's for almost 45 years. As a youth with no other equipment than an alert intellect, he convinced his company in 1894 that fertilizer manufacture was desirable, took charge of the development, and thus founded the Armour Fertilizer Works. This was only the first product of a resourcefulness that later led him into the soap, heavy acid, potash and mining industries, and into participation in national technical activities too multifarious to be enumerated. But commingled with the regret that time has now withdrawn him from active participation, his many friends will feel a gratitude that a double reward, in the form of personal leisure and a nation-wide recognition of his contributions to industry, has thus come to him.

Adapting Packed-Cell Operation to

REDUCTION of the ores from the Potrerillos mine of the Andes Copper Mining Co. includes acid leaching of the oxide portion, purification of solutions, and electrolysis. The purification step involves some combination of sulphuric acid with lime, with a discard of calcium sulphate which, with the consumption of acid by soluble impurities in the ore, makes current addition of fresh sulphuric acid necessary. It was to supply this acid that the plant at Potrerillos was constructed.

When the original plant was designed it was expected that the quantity of acid required would be 200 tons of 60 deg. Bé. a day. In order to provide for repair periods, possible increase in acid consumption, and other unforeseen possibilities, it was decided to design the plant for a production of 250 tons a day of 60-deg. Bé. acid in two units of 125 tons each. As the acid was to be used in dilute solution, the concentrations normally produced in a niter process plant (50-60 deg.) were suitable.

The location of the plant is at an elevation of 9,500 ft. above sea level with a normal barometer of 531 mm. of mercury. In this region earthquakes are frequent and sometimes severe, and design and construction were required to take that fact into account.

The available sulphur-bearing material is a flotation copper concentrate containing about 33 per cent sulphur. The copper content of this material has varied with mill practice from about 15 to 27 per cent. The subsequent metallurgy makes it desirable to leave from 15 to 20 per cent sulphur in the calcine. The concentrate is 75 per cent finer than 200-mesh. Drying furnaces for reducing the moisture of the concentrate to less than 1 per cent were provided for in the metallurgical plant.

Nitrate of soda is available at a cost much less than in the United States, since Potrerillos is within 200 miles by rail of producing nitrate officianas and no duty is included in the cost.

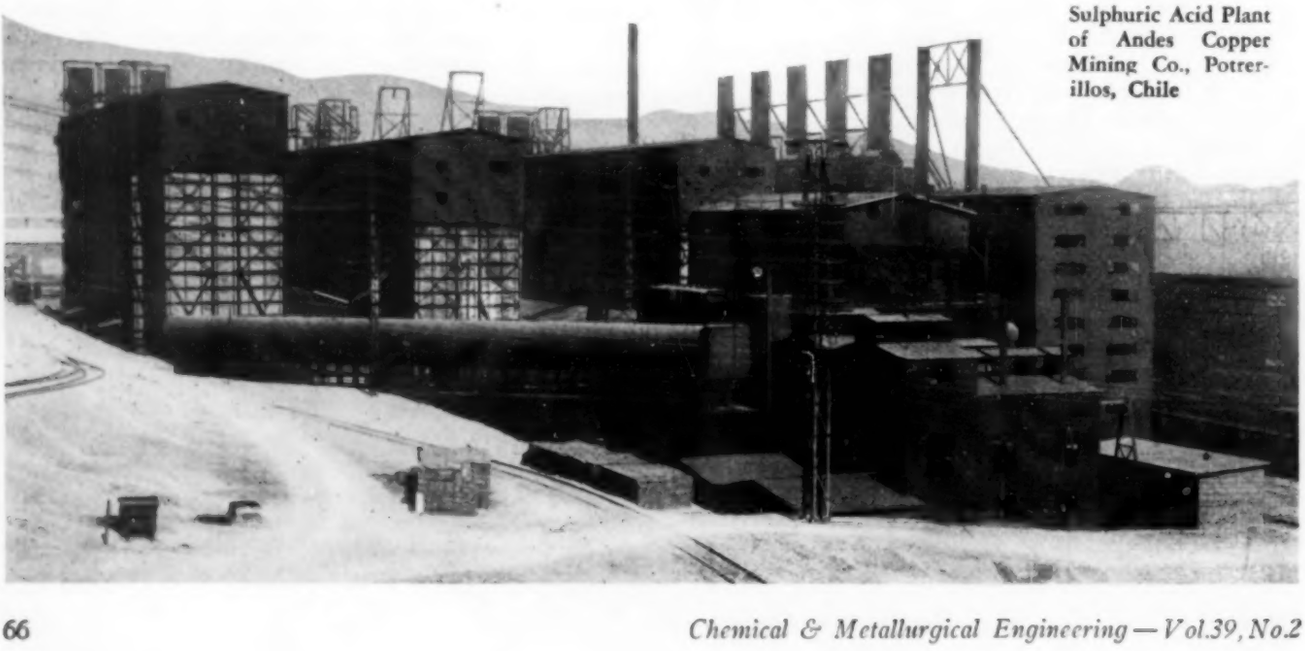
On the basis of data obtained at Anaconda, Mont. (*Chem. & Met.*, **26**, 1922, 642), supplemented by discussion of various points with those in charge of other modern acid and metallurgical plants, the following general features of design were decided upon:

1. The concentrate would be dried to not over 1 per cent moisture in air-cooled Wedge type roasting furnaces equipped with Cottrell treaters. This was considered the best type of equipment known for drying very fine concentrate involving a serious dust problem, as well as for roasting. Since experience had shown that about 8 per cent of the feed left the roaster in the form of very fine dust a Cottrell treater installation was included between the roasters and the Glover towers. As high-temperature gas was desirable at the Glover towers, the treater was to be designed to withstand temperatures up to 1,200 deg. F. and to lose as little heat by radiation as possible.
2. The acid system decided upon was the Larison packed-cell system, which was developed on a 20-ton-per-day scale at Anaconda. This presented the advantage of much lower construction cost than other niter process plants, and of requiring much smaller ground area, which allowed more convenient placing with relation to the other units of the Potrerillos plant.
3. Storage tanks of a capacity of 3,000 tons 60-deg. acid in two equal units were to be provided to carry over necessary breaks in production.

Concentrate Roasting Plant

The quantity of sulphur required for production of 250 tons of 60-deg. acid per day is 63.45 tons. If 96 per cent recovery were obtained the elimination from the roasters would be 66 tons. The acid plant at Anaconda contains two seven-hearth Wedge roasters 22½ ft. in diameter, which eliminate from concentrate 18 tons of sulphur per day. From this performance it was decided to use four roasters of substantially the same dimensions, which in operation now treat between 60 and 135 tons of concentrate.

The arms of these furnaces are air-cooled. Since they use the standard Wedge arm in which the air passages through the shank are necessarily rather constricted, the air is supplied at 10-oz. pressure, which has proved ample.



Sulphuric Acid Plant of Andes Copper Mining Co., Potrerillos, Chile

a Byproduct Sulphuric-Acid Plant In the Chilean Andes

By E. L. LARISON and J. B. CHRISTIE

Acid Plant Superintendents,
Anaconda Copper Mining Co.
Anaconda, Mont., and Potrerillos, Chile, Respectively

The dried concentrate is delivered on a trestle paralleling the roaster building in covered hopper-bottomed steel cars. These discharge into hopper-bottomed bins beneath, one for each roaster and each with a capacity of 1,187 cu.ft. These bins are equipped with 6-in. screw feeders to deliver the concentrate to the boots of elevators. The original feeder was a simple chute with sliding gate control, but it was unsatisfactory, due to excessive dusting.

The concentrate is elevated to bins located above the furnaces by heat-resisting double-chain elevators. Above each furnace is a hopper-bottomed feed bin of 250 cu.ft. capacity, equipped with a belt feeder with adjustable gate on the front of the bin. The belt feeders discharge their streams into star feeders opening into the top hearths of the furnaces near their centers. The matter of dust leakage has been troublesome in handling this fine dry concentrate. It has been necessary to weld or calk carefully every opening in the bins, elevators, and feeders to avoid this leakage, because of the extreme fineness and dryness of the dust.

Each furnace is equipped with a two-compartment Cottrell treater of bare steel shell construction for use during periods when gases are discharged to atmosphere, such as during starting up. The dust discharged from these treaters is drawn through pipes into the calcine hoppers below the furnaces. Current at about 40,000 volts is supplied to all Cottrells from a special substation.

Gas Handling and Treatment

The gas from each roaster is taken off through a cylindrical steel downtake lined with 4½ in. of firebrick, later supplemented with about 3 in. of magnesia lagging applied outside these flues. The diameter of each downtake is 4 ft. inside the brick.

These downtakes discharge into the top of a balloon-section flue parallel to the furnace building. This flue is a steel shell lined with 4½ in. of firebrick, and its circle is 8 ft. in diameter. Insulation was later increased by covering its top with several inches of loose volcanic ash from a local deposit. This flue is provided with gates on the bottom and connects the furnace downtakes with the high-temperature Cottrell treater. The temperature of the gases leaving the furnaces varies from 500 to 700 deg. C. Temperatures higher than 670 deg. promote sintering.

In roasting, dust to the amount of 8 per cent of the concentrate fed to the furnaces is produced. About one-third of this dust drops out in the balloon flue and is drawn off daily into cars on a track beneath the flue. The gases enter the Cottrell treater at temperatures ranging from 500 to 625 deg. C., carrying about two-thirds of the dust which left the roasters. About 96 per cent of the total solids entering are precipitated. The drop in temperature through the treater is about 70 deg. This treater is designed to clear the dust from gases up to 1,200 deg. F. The volume of gas to be treated is at that temperature approximately 1,160 cu.ft. per second. The active section of the treater is designed to produce a gas velocity of 2.5 ft. per second. The electrodes are designed to give 20 ft. of travel, so that the time in the electrode zone is 8 seconds. The treater is designed in two parallel sections, the cited figures applying when both sections are operating.

Louver dampers are provided at the entrance to each section to aid in gas distribution and to permit stopping gas flow through either section while plates are being rapped. Slide dampers also are provided at both ends of each section to permit either one being cut out completely for repairs or replacements.

The body of the treater consists of a steel shell supported on a structural steel framework, lined with 4½ in. of "Silocel" insulating brick and 9 in. of firebrick. The interior, in contact with the hot gases, the plate electrodes and the wire electrodes are of high-chrome steel. This metal retains its physical characteristics to a marked degree at high temperatures.

The receiving electrodes are 12-gage corrugated chrome steel plates. The discharge electrodes are No. 10 chrome steel wires. Plates were originally spaced at 8-in. centers but were later increased to 12 in., because

of a tendency for the wires to sway and limit the voltage.

The wires are rapped by a mechanical device and the plates by a hand-operated swinging hammer. Rapping is done hourly. Dust is withdrawn from the hoppers below the plates during the day and afternoon shifts. Accretions of dust which cling firmly to the wires constitute the most serious operating difficulty. When heavy rapping fails to dislodge this material the treaters are shut down and the wires are scraped. This is necessary about once in eight months.

Glover Tower Construction

The gas is conveyed to the Glover towers, of which there is one for each acid unit, through steel brick-lined rectangular flues. The towers are built on reinforced concrete foundation blocks, are of rectangular section, and consist of structural steel frames supporting 10-lb. lead shells, interior brick walls and brick packing. The tower pans are built of 40-lb. lead, lined with brick. Into these the curtains hang, forming acid seals.

These towers are 16x30 ft. and 50 ft. high outside the lead. The height of packing proper is 38 ft. The interior walls decrease from 24 in. at the bottom to 9 in. in the upper portion. The lining and packing of these towers is of hard burned shale brick made in the Pacific Northwest.

The gas enters each tower through two flues, 3 ft. wide, and leaves the top through three lead flues, 30 in. in diameter, which lead to the packed cells.

In front of each Glover tower are three coolers consisting each of a lead tank lined with acid-resisting masonry supported in wood cribbing and containing 24 coils of lead pipe. Any coil may be removed for repair or replacement without disturbing the other coils. About 1,800 tons of cooling water is circulated through these three coolers every 24 hours.

Above the tower are mounted four lead tanks supported in wood cribbing, two for nitrous vitriol and two for mixed acid. Distribution of acid into the towers is made through distributor boxes containing gage plates and splash heads.

Severe Operating Conditions

Manufacture of acid from byproduct gases always presents more difficulties than from brimstone gases, and in the case of the Potrerillos plant the number of difficulties is unusually great. First, the source of SO_2 is not favorable. Due to the necessity of daily spading and cleaning of furnaces, the percentage of SO_2 varies widely during day shift, sometimes as much as 3 per cent within 15 minutes.

The concentrate roasted contains between 1 and 2 per cent As_2O_3 and a large part of this accompanies the gas as vapor into the Glover towers. The gases are extremely dusty and there are many variations in gas tenor and volume due to coping with this dust.

The effects of the low normal barometric pressure of 531 mm. are very marked in reactions involving gases. If we apply Wilhelmy's law of the effect of pressure upon velocity of reaction, we find that in this case reaction varies directly as the square of the pressure. This conclusion is substantiated by comparing the reaction rates in similar plants at Anaconda, Mont., 5,300 ft. above sea level, and at Potrerillos, 9,500 ft., which would be as $760^2 : 531^2$. The plant at sea level would operate with 49 per cent of the reacting niter needed by the more elevated one. And since niter loss is proportional to the quantity circulated, the loss in a plant at high elevation is necessarily higher than in a plant located at sea level.

Other conditions remaining the same, niter consumption also will vary inversely as the square of the pressure. The quantity of nitrogen oxides introduced into the Glover towers as nitrous vitriol plus nitric acid is equivalent to about 0.9 lb. $NaNO_3$ per pound of sulphur recovered as acid. The recovery of the niter introduced into the Glover towers amounts to about 93 per cent. The loss of niter in this plant therefore is about 7 per cent on the sulphur in acid recovered.

Packed Cell Installation

The Larison packed cell process was described in the article already cited. The basic difference between this process and the ordinary lead-chamber process is that packed cells or towers have been substituted for open chambers. Over these towers a heavy circulation of cold 50 deg. acid is maintained. The vigorous mixing and impingement of reacting gases upon wet surfaces stimulates reaction in a surprising way. The circulating acid removes heat generated by reaction independently of radiation.

There are five packed cells or reaction towers in each unit, all of uniform design and dimensions. Each tower consists of a concrete foundation, a pan of 15-lb. lead, a steel frame supporting a 10-lb. lead shell, and packing of brick. These towers are of rectangular section 12x36 ft. and 53 ft. high. The height of packing proper is 41 ft. There are no interior brick walls. The flow of gas through these packed cells is alternately down and up. The connections between towers are in each case three 30-in. lead pipes.

Each set of five packed cells is provided with a set of three coolers in series. Each cooler consists of a lead tank supported in a wood cribbing and containing coils similar to those used in the Glover coolers. These coils are connected in series, the cold water entering a coil in the lowest tank and passing thence to coils in the second and first tanks successively. About 2,000 tons of water per 24 hours is circulated. Acid issuing from these towers enters a common launder which carries it to the coolers described.

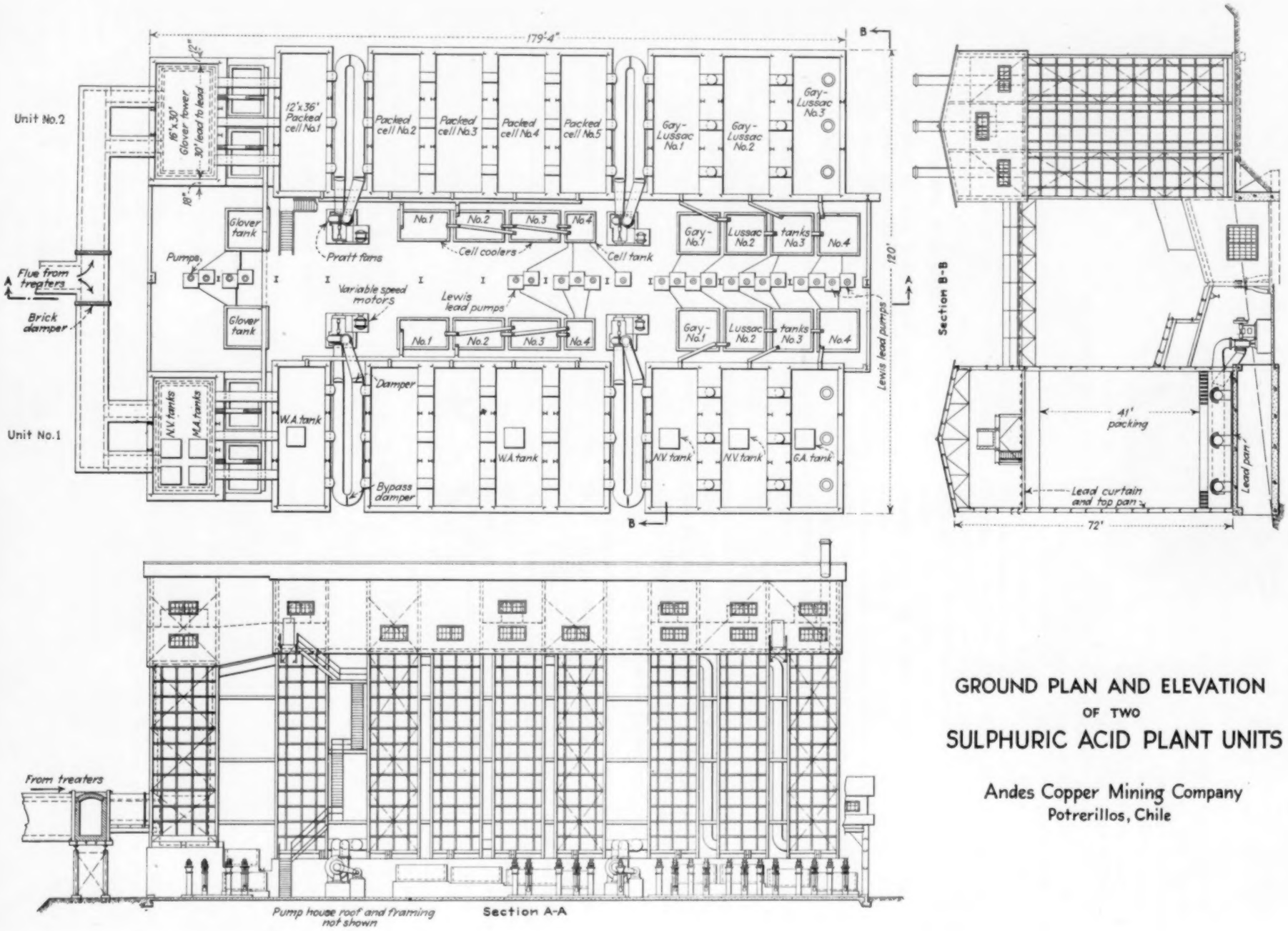
Two lead tanks are provided, one above Cell 2 to feed the Glover and Cells Nos. 1 and 2, and another on Cell 4 to feed Cells Nos. 3, 4, and 5. The distribution of acid is made as in the Glover tower.

Gases enter the Glover tower at temperatures ranging from 400 to 500 deg. C. The SO_2 content of gas at this point ranges from 3.5 to 8 per cent, the low figures being accounted for by furnace spading. The average is near 7 per cent. Gas leaves the Glover tower at about 90 deg. C. and at that point contains about 5.5 to 6.0 per cent SO_2. On leaving the last reaction tower the gas is at about 37 deg. C. and its SO_2 content about 0.05 per cent. Weak acid enters the reaction towers at 25-30 deg. and leaves them at 75-80 deg. C. The volume circulated is 10 to 12 times the production of the plant.

Gay Lussac Towers

Three Gay Lussac towers are provided for each unit. They are of the same size and construction as the packed cells. Gas flow is upward in each. Flue connections between towers consist of three 30-in. diameter lead pipes. Each tower is provided with a top tank and an acid distribution system similar to those used on the Glover tower and the packed cells.

The operation of the Gay Lussacs is unusual in that



GROUND PLAN AND ELEVATION
OF TWO
SULPHURIC ACID PLANT UNITS

Andes Copper Mining Company
Potrerillos, Chile

a circulating load of acid is maintained over them in addition to the regular quantity advanced to the Glover tower as nitrous vitriol. In this way an ample uniform flow of acid is at all times maintained over each Gay Lussac tower. The quantity of acid introduced into each under this system is about 950 tons per 24 hours, or about 2.2 tons per square foot of horizontal tower area. The nitrous vitriol issuing from the first Gay Lussac tower and advancing to the Glover tower contains nitrogen oxides equivalent to 70-80 oz. $NaNO_3$ per cubic foot.

These acid units were designed to make 125 tons 60 deg. acid each, but it has been found possible to make in each of them 150 tons. Operating at this rate the gross volume of the reaction towers amounts to 1.5 cu.ft. per pound of sulphur in acid recovered per 24 hours.

Fans, Tanks, Pumps

Movement of gas through the plants is caused by four hard-lead fans in each unit. Two fans are located between Cells 1 and 2, and the other two between Cell 5 and Gay Lussac, one in each.

Receiving tanks for acid issuing from the towers are of uniform size and design. They are 10 ft. square by 4 ft. 6 in. high, and are built of 10-lb. lead supported in a cribbing. They are supported at suitable elevations upon concrete piers set on a sloping mastic covered floor.

Launders are provided to permit diversion of acid, with cross-connections to make it possible to maintain constant flow into the Gay Lussac towers irrespective of the feed of nitrous vitriol to the Glover tower. The advantages of this system are described in *Chem. & Met.*, **35**, 1928, 229.

The pumps used throughout this plant are Lewis vertical acid pumps with a capacity of about 1,500 tons 60-deg. acid at the lift required in this plant. The feed lines from tanks to pumps are of 3-in. lead pipe. A plug seat and a hard lead plug on a long stem is provided for each feed line. The discharge lines are 3-in. wrought iron pipes and in each near the pump is a free-flow "Acimet" hard-lead valve for controlling volume of acid pumped. Two pumps with feed and discharge lines are provided for each duty, so that any one pump may be out of operation for repairs without disturbing flows. The top tanks are provided with an electric signal system which shows by means of lights on a board near the pumps the level of acid in each top tank.

Mixed Acid Plant

With nitrate of soda closely available for this acid plant, the satisfactory plan worked out at Anaconda and used there for the past ten years was adopted as a model. This plant, described in *Chem. & Met.*, **26**, 1922, 642, provides for decomposing nitrate of soda with sulphuric acid in retorts heated by coal fires, condensing the nitric acid evolved in a tower over which cold sulphuric acid is circulated, thereby making a mixed nitric-sulphuric acid. This is introduced into the Glover tower or the circulation tanks to make up the niter loss suffered in the sulphuric-acid process.

This plan has the advantages over nitric pots placed in the flues of reduced labor, more uniform introduction of nitric acid to the process, avoidance of admission of false air, almost no limit to rate of introduction, and greater cleanliness.

The installation consists of two nitric-acid retorts with hemispherical bottoms, in brick settings designed for oil-firing. Each retort comfortably decomposes 2,000 lb. of nitrate per 8-hour shift, including charging and tapping. Molten niter cake is tapped out into a launder through which water flows, and is carried away in solution.

The nitric-acid vapor evolved is carried in Corrosiron pipes with horizontal bell joints to the condensing tower, which is 20 ft. high and 4x4 ft. inside. It is constructed of vitrified shale brick and built in a pan of 24-lb. lead whose upper sides are of cast Corrosiron plates. The walls are two in number, a 9-in. main wall and a 4-in. veneer course separated 2 in. from the main wall but bonded to it for support in several places. This construction prevents acid leaking through to the outside. The tower is packed with rectangular brick.

Acid is fed into the tower and distributed through a hard-lead splash plate. It issues from the pan into a brick-lined lead tank containing water-cooling coils and is conveyed by a lead launder to any one of the six brick-lined lead storage tanks, whence it may be circulated to the mixed acid tanks on the Glover towers. A six-inch pipe containing an air jet leads from the top of the tower to a point a short distance above the roof of the building.

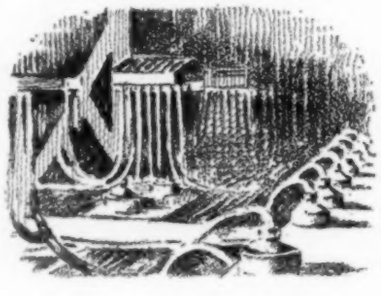
The product of this plant is a mixed nitric-sulphuric acid containing nitric acid and lower oxides equivalent to about 16 lb. $NaNO_3$ per cubic foot. This mixture is not corrosive to either lead or iron.

Operating Personnel

The superintendent, general foreman, three shift foremen, and repair foremen are North Americans or Europeans. All others are Chilean, chiefly recruited from labor employed during plant construction. However, once trained, they have proved to be good operators and labor turnover is not high among trained men. At the inception of operations none of them was trained in any sort of plant work.

For full-scale operation a native crew of 13 is required on each 8-hour shift. The plants require a repair crew of six to nine men on day shift, who do all ordinary repairs, a day crew of six men for spading furnace floors, and a yard gang of five men to do general work. The efficiency of the labor used depends to a great extent on the thoroughness of supervision, plant foremen forming the key of the organization. The roasting plant is operated by the acid division in order to insure maximum correlation.

The two original acid units were constructed in 1927 and put into operation in 1928. In 1930 a third unit was added, so that the present capacity of the entire plant is 450 tons per day of 60-deg. acid. These plants were built in extremely substantial fashion throughout, in order to enable them to resist earth tremors. Their cost, however, was only about 60 per cent of that of well-designed chamber plants of equal capacity.



Palace of Culture at the Chernorechenskaya Chemical Combine in the Town of Dzerjinsk

Engineering Observations in the U.S.S.R.

The Supreme Economic Council of the U.S.S.R. is now in session, under Stalin, to formulate a further industrial plan. In the timely observations on the present condition of the Union presented below, the speakers are both eminent engineers with a wide technologic and executive background. Mr. Carmody, who visited Russia in 1931 as representative of the McGraw-Hill Publishing Co., presents the views of the interpreter unprejudicially peering into the course of the U.S.S.R. In the other case we have the correspondence of an American engineer who was invited to the Soviet Union for two years to appraise critically methods and equipment involved in the pursuance of the Five-Year-Plan. He therefore speaks from the inside. The authors have traversed the length and breadth of the country, examining raw-material resources, plants, processes, and methods of production in the most diversified industries.

By JOHN M. CARMODY

Publishing Director, Factory & Industrial Management

WHY do no two writers or speakers tell the same story about Russia? I have been asked this question several times since I came back. I think I asked the same question before I went. The answer is that no two people who go there, particularly if they go at different times, see exactly the same things. Conditions change rapidly. Yesterday's prairie becomes today's construction job and tomorrow's industrial plant. Feverish activity began three years ago. Only those who tried to find the right man to do business at Hog Island or some similar place during the World War appreciate the drive behind U.S.S.R. business today—unless it be the same man who cooled his heels in some outer office in Washington during that same period. I did this in 1918. I did it all over again in Moscow in 1931! And for the same reason: too rapid expansion.

There are other reasons for divergent stories about the U.S.S.R. The whole philosophy and arrangement of life and work is different from that to which we are accustomed. Every activity, political, social, and industrial, is set up on a new basis. It is an experiment that is being tried out, not in a laboratory but on a gigantic scale over one-sixth of the earth's land surface and involving 160,000,000 human beings. Proponents acclaim it a new form of civilization. They insist that the long-range industrial program, which is now attracting world-wide attention, is only a means to an end and not an end in itself.

Is it any wonder that single human beings from the United States and from other similar countries are themselves a bit confused when they find themselves face to face with the realities of such an experiment just now in its swaddling clothes? The Russians seem intent on packing into 20 or 30 years what amounts to a life time of development in maturer industrial nations.

Can they do it? There's the rub. Does anyone really know? Will anything but time give a reliable answer? Perhaps not. In the meantime those who are seriously interested, either through fear of how success in the U.S.S.R. may affect them or through a desire to participate commercially in such progress as may grow out of it, must be guided by the best available advice.

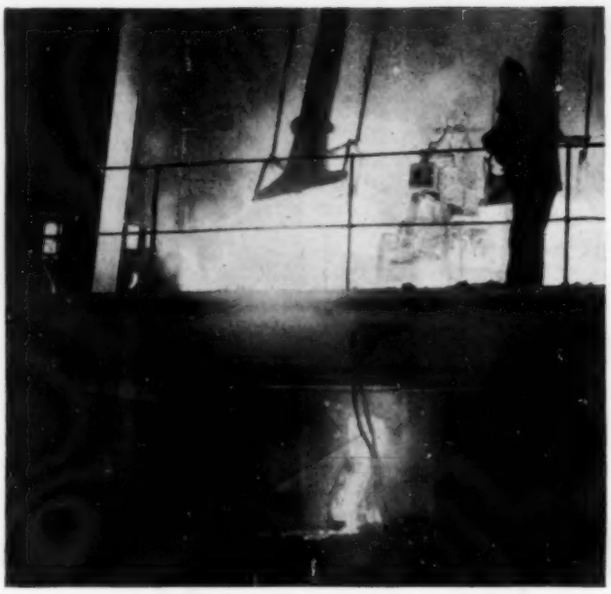
The business of the country is being operated by large trusts. A trust has control over all the activities and all the functions within a specific industry. There is one trust that controls all railroad transportation, and another that controls the chemical industry, and so on. Many of these trusts have subdivisions corresponding to some of our large companies. Then the activities of all these trusts, outside of agriculture, head up in what is called the Supreme Economic Council, referred to in Russia as V. S. N. H.

Everybody in Russia is either studying something or teaching something. I think that is pretty generally true. They certainly go to school a lot. Everybody has a briefcase under his arm—every boy and girl and engineer. I met a Russian engineer on the train. In his Russian and my English he explained to me that he was designing a new excavator to be a better excavator than one of our 50-ton machines. He showed me the drawing which was copied. He was complaining because some of the drawings he got, some of the catalogs, didn't have all the details—and they had to tear a machine down and measure it. Quite naïve.

Along with the building of plants and houses and schools go what they call workers' clubs or cultural clubs. I found them everywhere in Russia; large buildings, the so-called new German modernistic architecture, not very handsome from the outside but efficient, with a theater that will hold from 1,000 to 2,000 people, depending on the size of the plant and the size of the town, a great many school rooms full of exhibits and charts. If any child in Russia doesn't know exactly how many more acres of wheat can be raised on an Ukrainian field than on a field in Illinois, it is not the fault of the Russian Government. They have every conceivable bit of information about every phase of our life, health, agriculture, dairying, industry, the difference between the strength of materials, and everything you can think of, on charts in these places. There are thousands of boys and girls and men and women in these places at night.

Rationalizing about Russia is extremely difficult because of the bias, for or against, expressed almost continuously since 1917 by many writers and speakers. I know of no way, however, by which any of us can do an intelligent job in, with, or about Russia unless we look at that country objectively.

It is for that reason that I recommend the succeeding article by an American engineer. I had a letter of introduction to him when I went to Russia, given to me by one of his American friends, a man of wide travel and broad business experience. Unfortunately, I did not see him in Russia. We were both traveling hard and our paths did not cross. I learned of his work, however, from other American engineers and from Russians.



Few men in the U.S.S.R. have had a better opportunity to study conditions at close range during the past two years. He has lived in the cities and in the villages. He has been on construction jobs. He has sat in on one project after another from the initial plans to their completion. He has dealt with engineers, workers, and officials. He may be a bit less optimistic about our ability to work out of our own depression than we here at home are. This is characteristic of all nationalities away from home. At least I have found them so during other depressions when I lived abroad.

The immediate future of our own trade with Russia depends almost entirely on how soon the world recovers her economic equilibrium. Lack of recognition does not appear to have been much of a handicap to trading during recent years. Russia has bought about all she could pay for and as much of it from us as we cared to sell on her credit terms. Had she had gold or had our government supported credit as did Germany and England, our manufacturers undoubtedly could have sold her millions

Voskressensk Chemical Combine in Construction, to Serve

Arc Smelting of Carbide in New Carbide Furnaces at Chemical Combine in Dzerjinsk

The Inner Viewpoint on a National Industrial Experiment

By an American Engineer in Russia

and millions that finally went to those countries. But that is another story, to be judged only by the eventual solution of present economic difficulties.

The fact is she can buy machinery (she buys almost no consumer goods abroad) only as she sells raw materials such as timber, oil, coal, fur, caviar, wheat, some fruits, and a few simple manufactures such as matches or candy. The drop in raw material prices began to affect her in 1930. She met this by exporting larger quantities. The crash that came to Europe in 1931 and to the rest of the world, however, did more than reduce prices. It shrunk the market to a point where few countries could continue to buy much at any price. Inasmuch as expansion in Russia at this stage depends on foreign machinery, this tends further to slow up the program.

Even this may not be serious, however, because Russia has already turned away from further immediate expansion of heavy industry toward consumer goods production. New plants will be required here, too, but they will be smaller and not nearly so expensive to build or equip. The second Platiletka may afford the breathing spell Russia needs without the heartache the rest of the world is experiencing during its depression breather. Who knows? Perhaps some of these American engineers in Russia can help us understand.

SOVIET ECONOMICS have gotten fairly out of the realm of the academic. We should, in other parts of the world, be taking it to heart in its actual setting, squarely in the realm of practice. I certainly feel, here on the ground, that while the U.S.S.R. has not yet developed an economy that challenges that of any Western land on the basis of realized accomplishment, there is substantial prospect of progressive improvement in Communist production. There does exist, in other words, a more or less established alternative to our form of economic organization. Its desirability, not its possibility, is the point that is to be settled by the world in the next generation or so.

Certain it is that the Five-Year Plan is going strong. Already it has aspects that border on the miraculous. Those who say here that the tempo is too fast find themselves with habitats not of their own choosing; those who are determined it shall go over are at the Kremlin, waxing stronger. The people—who shall say what 160,000,000 of them are thinking?

A generation of young men and women is beginning to function that has come through the Communist school, knowing no old Russia of individual wealth and poverty. Trained to the Communist ideal, this new generation knows only the U.S.S.R. of present-day mass conditions, and its efforts to improve these are strictly orthodox. To a Communist régime committed to the Piatiletka, this new blood is a tremendous asset, a powerful reinforcement with which to carry on. If one stays long enough and develops contacts wide enough, there is to be detected in that part of the population known as "responsible workers" a feeling of peculiar buoyancy. The fact that the mass may incline at times to discouragement and impatience counts but little in the face of this momentum of conviction, determination, and belief that a new order of business, society and general well-being is at hand, though hardships prevail on every side.

Moscow Region With Sulphuric Acid, Phosphates, and Superphosphates

An outstanding industrial obstacle, so serious that it may prove to outlast all others, is an indifference and inertia on the part of labor, which has the pernicious psychology of being owner of the plant in which it is a worker. With indifferent respect for executive authority, this rôle of master ill befits the worker.

Another factor looming large is the currency inflation that has come about in the internal financing of the Plan. The leaders are concentrating on these two matters as national emergencies, and the Kremlin has been successful in other struggles as basic. The irresponsibility and low morale of labor, though a huge load for the leaders to carry, is slowly and ponderously improving as propaganda and education, extend their influence.

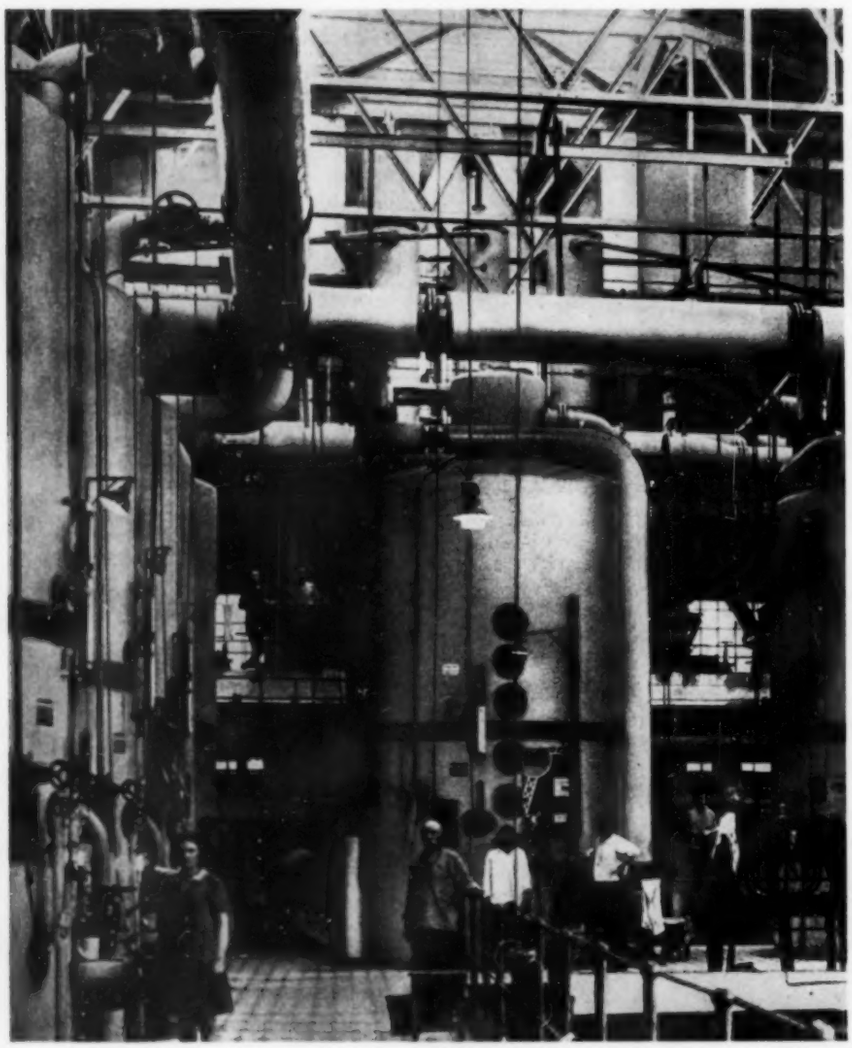
Perhaps the greatest single difficulty that remains in Soviet industry today — one that foreign engineers unanimously condemn and constantly berate—is the absence of centralized authority and responsibility in the field. There is plenty of authority and an abundance of responsibility, but at each and every industrial unit this authority is divided among four or five heads. One-man authority is, of course, incompatible with Soviet precept and the idea of it seems next to impossible to accept.

It is easy for the citizen of the U.S.S.R. to believe that he sees elsewhere the breaking down at last of an impossible capitalistic system. He knows that all thinking men are questioning whether there is excuse for the terrific scope of this world depression. And the two great "U.S." countries are at opposite ends of the economic spectrum. Both possessing enormous and almost self-sustaining resources, they present the obverse sides of a coin: over-production and unemployment on one side, lack of goods and shortage of man power on the other. This market for American goods and labor is bottomless. Why not blast away the dams and allow the trickling current of business full channel?

It is largely inertia to think, and say, that it isn't the thing to do, ethically. The way, if there be one, to exert influence here and in some measure bring about the relation we want is cooperation. Approval is not involved in diplomatic recognition, and already we are doing business. A cold, practical analysis of the trade situation amounts to this: the Soviet Government is impervious to frown or criticism; it is doing business and, so far, paying its bills; it will continue to grind on, come what may; it can buy and pay for tonnages of American products that are staggering.

The economic menace as to the flooding of foreign markets by Russian goods is in the long view somewhat overestimated. If it is in the ordered economy of the world's progress that cheap commodities—enormous quantities of them—are to come out of Russia, there is no stopping them, and we may as well get set. As years go by, the world has got to have, and will have to take, in its ultimate article of commerce, cheaper materials, and these materials will come inevitably from the world's richest, most favored regions. There's as much chance of an international control of commodities, in the long run, as there would be of an international control on the law of gravity.

Vacuum Tanks at Stalin Sugar Factory in Lokhvista, Built in 6½ Months and Handling 1,000 Tons of Beets Daily



In further comparison, it appears to one looking out from the midst of this Soviet effort at economic readjustment, that the Machine Age elsewhere in the world fairly screams for the injection of broad-visioned control. The human, social factor of progress must be carried along more or less in tempo with the material—and this we have not been doing. Business generally, for the past ten years, has been buried under its problem of production. The resultant dislocations in the labor corner of the picture have been largely left to the elements. The course of the depression itself has brought out the fact that the industrial social system of the past several decades had gotten unbelievably weak—the depression has drawn aside the veil that had been covering this social defect from the greater part of the world for so many years.

In the U.S.S.R., a social, industrial machine has been put together and into motion, that is sweeping on in a manner bewildering to even its creators. The point the Western industrialist must ponder is the fact that such a system is grinding on, its roots and foundations in an extraordinarily favorable soil.

Transportation Features C.G.M.A. Meeting

EDITORIAL STAFF REPORT

THE nineteenth annual meeting of the Compressed Gas Manufacturers' Association was held in New York City the week of Jan. 25. At the technical sessions several interesting papers were presented dealing with applications of compressed gases and the development of suitable containers for transportation.

In his paper concerning the use of carbon dioxide as a refrigerant in railroad cars, C. W. King, of the Dry Ice Corp., discussed results of investigations being made upon the effect of this gas on perishable products. He stated that indications are that within certain ranges the gas enhances their keeping qualities. In addition, certain concentrations make possible the carrying of many products at higher temperatures. Research shows that for every product studied there are certain concentrations when beneficial results are noticed.

In a few places the cost of Dry-Ice refrigeration directly competes with that of water ice, but in the majority of instances it is greater. It may be assumed that its cost will be more in keeping with the standard set by water ice as soon as volume is justified. To set volume as a cause for price reduction instead of market expectancy is both economic and sound. Therefore, by increasing the volume in fields foreign to refrigerator cars and introducing cars in fields where its merits warrant an increased cost, there is no reason not to expect that an orderly increase in tonnage will eventually make the cost economical to all users.

Recent developments in tank cars were described and discussed by L. A. Belding, of the General American Tank Car Corp. Heater coils have been applied to the outside of insulated forge-welded tanks and are used for carrying 60,000 lb. of sulphur dioxide. It is thus possible to heat and dry the interior of the tank before the dry material is poured into it, and consequently the delivery in bulk is insured just as clean and dry as that formerly delivered in smaller packages. This same type of car has come into use for the transportation of tetra-ethyl lead fluid used in making anti-knock gasoline.

Aluminum tank cars are successfully transporting glacial acetic acid, acetic anhydride, glycerine, formaldehyde, and concentrated hydrogen peroxide to a variety of industries. Iron rust that is picked up from steel tank cars seriously interferes with the use of formaldehyde in the manufacture of plastics, photographic film, inks, and artificial leathers. This is now avoided by shipping formaldehyde in insulated aluminum tank cars which preserve the clear water-white condition. Until recently even large tonnage shipments of glycerine had to be made in glass bottles. Now it is delivered in aluminum cars to manufacturers of cold creams, cosmetics, and medicinal compounds, maintaining the same purity as when delivered in glass bottles.

Another important type of tank car, glass-lined refrigerated and built primarily for the transportation of milk, is pointing the way to new uses and economies. The nickel-lined tank car is destined to save $400,000 for one rayon manufacturer who consumes 50,000 tons of caustic soda a year, because the cars will deliver liquid caustic soda without iron contamination. Cars constructed by spraying their interior surface with metals such as tin, aluminum, zinc or copper are entirely suitable for lading such as corn syrups, sugar syrups, and the weaker organic acids.

In just the way that it is possible to pump various liquids into and out of tank cars, so we are beginning to pump granular materials such as wheat flour, portland cement, lime, and feldspar to and from special tank cars. The labor saved by this pumping of granular materials to and from tank cars with conveying equipment built therein, over packaging such materials, and by placing them in box cars, is enormous.

The economic distribution of liquid chlorine was the subject of a paper presented by W. L. Savell, of the Mathieson Alkali Works. The author stated that the major difficulties in obtaining satisfactory distribution of liquid chlorine as an industrial or sanitary chemical were those of packaging and transportation.

Beginning with the shipment of a single cylinder in April, 1909, followed by a tank car later in the same year, the industry has grown to a point where it requires 700 single-unit cars, hundreds of multi-unit cars, and hundreds of thousands of cylinders. The pulp, paper, chemical and textile industries, and sanitation account for more than 75 per cent of the total chlorine consumption. The remainder is distributed in various proportions to a wide range of industries, including food production, metallurgy, lumber, and drugs.

Blank & Stoller

Left: J. A. Kienle, Mathieson Alkali Works, Elected President of the Compressed Gas Manufacturers' Association; Right: F. R. Fetherston, Re-elected Secretary and Treasurer

In a thorough treatise on the development of containers for the transportation of gases under pressure, C. E. MacQuigg, of the Union Carbide & Carbon Co., and J. J. Crowe, of the Air Reduction Co., stated that the properties of an ideal cylinder would be maximum strength combined with minimum weight, with perfect resistance to corrosion and freedom from faults in the cylinder. An additional desirable property would be to have containers so shaped that they could be packed in cars or on trucks without waste space between them. This, however, would mean a container of a square section, which would be out of the question on account of the bending set-up in the walls.

Towers and Packings for Chemical Plants

By ANDREW M. FAIRLIE
Consulting Chemical Engineer
Atlanta, Ga.

CHEMICAL towers may be divided into three classes: namely, packingless (void or *vide*) towers equipped with some sort of spraying or atomizing device; bubbling towers or columns; and packed towers. These three classes are used for a variety of different purposes such as the absorption, cooling, drying, cleansing or humidifying of gases; the evaporation (concentration), cooling or heating of liquids; or for reaction purposes. The nature of the operation involved must be considered in reaching a decision as to the kind of tower to be adopted.

Packed towers may be of almost any size, ranging from the small glass laboratory drying towers, 2 in. in diameter and 10 in. high, to industrial towers of great height and volume. The latter may be considered as ranging in size from 2 ft. in diameter and 10 ft. in height to 30 ft. in diameter and 70 or 80 ft. in height. The smaller sizes—say, from 24 to 60 in. in diameter—usually are constructed of standardized cylindrical tower sections made of chemical stoneware. Such towers usually are packed with packing units of small size, in consequence of which the resistance to gas flow per square foot of cross-sectional area usually is high, particularly in small towers.

Chemical towers of large size usually are built of brick or of masonry blocks, laid up in acidproof cement. Sometimes, as in the case of Glover and Gay-Lussac towers in the sulphuric acid industry, the brick walls are sheathed on the outside with sheet lead, while some Gay-Lussac towers have been built of sheet lead with the brick lining walls omitted. On the other hand, within the past 15 years, many "all-masonry" Gay-Lussac and Glover towers have been erected without any lead sheathing. Absorption towers in contact-process sulphuric acid plants are made of cylindrical steel shells lined inside with acidproof masonry.

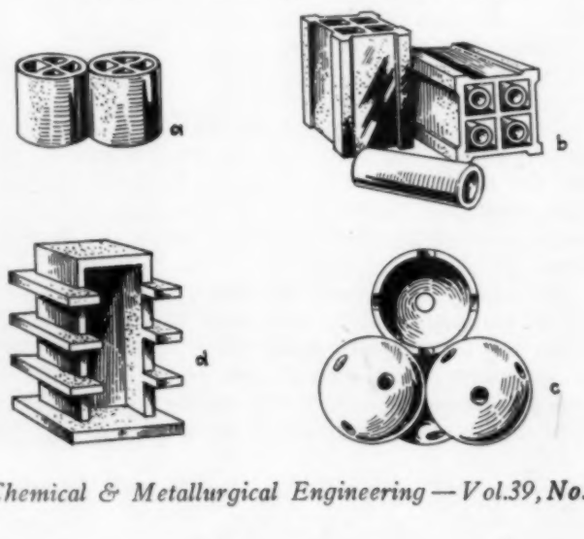
Modern nitric acid plants of large capacity, operating on nitrous gases produced by the combustion of ammonia, employ for the absorption of the nitrogen oxides large towers having a shell made of chromium-steel alloy. Towers of steel and other metals and alloys likewise are used extensively in other industries, particularly in petroleum refining.

Tower size and shape may vary according to the nature of the gases and liquids to be handled, according to the purpose involved, and the ideas of the designer. Square towers are sometimes objected to on the grounds that the corners cannot be adequately irrigated and that the square shape is less stable than the circular. On the other hand, the square tower offers the advantage that it can be built of brick of standard shape and size, whereas radial bricks must be used for the circular tower. Furthermore, the square tower utilizes more efficiently the ground space that it occupies. Chemical towers are usually either square or circular in cross-section, but are occasionally octagonal or rectangular.

It has been suggested that a large absorption tower should not exceed 10 or 12 ft. in diameter, and that the height should be five or six times the width. The ratio of diameter to height of a small stoneware tower (3 ft. in diameter or less) may be as great as 1:4, although a ratio of 1:5 or 1:6 is considered better. In the case of very large industrial plants or even of some moderately large ones, it would be inexpedient to limit the diameter of the towers to 12 ft., both on account of the resistance to gas flow which would result where a large volume of gas has to be handled and on account of the expense of constructing a great many towers. In the United States, many towers, 20, 25 or even 30 ft. wide, can be found at large chemical plants, and the height of these usually is not more than 60 or 70 ft. Where a wide tower must be used, the deficiency in height can be overcome by the use of two or more towers in series. It should be observed, however, that in all cases the tower space desired should be obtained with as few units as is practicable, for the reason that in each unit the unpacked spaces beneath and above the packing are not effective spaces but nevertheless constitute an important part of the cost of each tower.

The fact that the bottom and top portions of the packing itself, in wide towers, are only partially effective must also be considered. The inlet and outlet gas connections, the liquid feeding devices, and the unpacked spaces at the top and bottom of each tower may cost as much as 40 per cent of the total cost of a tower. It is apparent, therefore, that these necessary but non-effective parts of the tower should be avoided, in so far as practicable, by encompassing the total packed space desired in a few large units rather than in many small

Fig. 1—Typical Manufactured Tower Packings; *(a)* Partition Rings; *(b)* Partitioned Tile and Tube Packing; *(c)* Hollow Balls; *(d)* Obsidianite Packer



ones, aiming at a reasonable balance between erection cost and operating expense.

For the construction of all-masonry towers, various kinds of chemical cements are on the market. The bonding agent generally is silicate of soda. According to Snell and Farkas (*Ind. Eng. Chem.*, 23 (1931), 525), three grades of acid-resistant silicate cement are recognized: namely, ordinary mixtures of aggregate and silicate of soda solution, requiring from seven to ten days for a satisfactory set; mixtures containing a neutral or an alkaline component, capable of setting in from four to five days; and mixtures containing an acid ingredient which will set completely in 24 hours. Slow-setting cements are workable for an hour or two after being mixed (or after being opened, in the case of ready-mixed cement), or until they begin to dry. Rapid-setting cements, such as "Vitric 10," made by the U. S. Stoneware Co., take a partial set in from 10 to 15 minutes, after which they are not workable. Some of the slow-setting cements, such as "Acipruf" cement, made by the Chemical Construction Co., require the addition of silicate of soda before use. Others, such as the ready-mixed plastic cement made by the Quigley Co., require no additions. A formula that has been recommended for chemical masonry construction is: finely ground silex, 90 per cent; barium sulphate (200 mesh or finer), 10 per cent by weight. Silicate of soda is added to the well-mixed powders, as required for use.

The preparation and use of silicate of soda mortars of this character require experience. Because they tend to harden on exposure to the air, only such a quantity should be prepared as can be used within about two hours. The mortar should be of the consistency of pancake batter, very thoroughly mixed, thick enough to be spread with a trowel but not thick enough to roll up or crumble. In laying brick, the mortar should be spread on the work already laid, and on this the brick to be laid is pushed with hard downward pressure and finally is tapped into position. This produces the thin joint ($\frac{1}{16}$ in. thick) essential for this class of work. Bricks may be "buttered" with mortar previous to laying, but the practice of dipping bricks into the mortar must be condemned. Dipping invites the preparation of thin mortar, containing too much silicate of soda. Any attempt to use rush methods in acidproof masonry construction is likely to result in imperfect, leaky joints and a generally unsatisfactory job. Prior to construction, brick should be kept in a dry place and the work should be sheltered from rain and freezing during construction. Masonry must be air-dried several days, after which the joints should be painted or sprayed with 60-deg. Bé. sulphuric acid. Depending on the type of cement used, the work must stand up to 7-10 days before being put in service.

The brick used in the construction of a large acid tower should be as definitely chemical stoneware as the cylindrical sections used in erecting small towers. Chamberlain makes a strong plea (*Chem. & Met.*, 38 (1931), 142-4) for close cooperation between the user and the manufacturer of chemical stoneware. He points out that there are as many as 15 different clay bodies of varying properties available for chemical stoneware and that the ware should be designed especially for the specific service. The use for tower construction of even the hardest burned of ordinary building brick is likely to lead to regrets. Not only are the materials of such brick poorly resistant to corrosive chemicals but they also are likely to be unsuited mechanically. Kingsbury (*Ind. Eng. Chem.*, 19 (1927), 693) has shown that, in the manufacture of chemical stoneware, a range of ceramic products extending from ware having the coarse texture and porosity of firebrick to the density and impermeability of porcelain may be obtained. Whereas the more porous bodies have greater resistance to sudden changes in temperature, the denser structures are more resistant to penetration by acids. Kingsbury has quoted as practical for chemical stoneware the following ranges: tensile strength, 1,000 to 2,500 lb. per square inch; compressive strength, 25,000 to 80,000 lb. per square inch; modulus of elasticity, 6,000,000 to 10,000,000 lb. per square inch; thermal conductivity, 0.6 to 0.9; specific heat, 0.185 to 0.190; specific gravity, 2.06 to 2.36; and coefficient of expansion, 0.0000023 to 0.0000027.

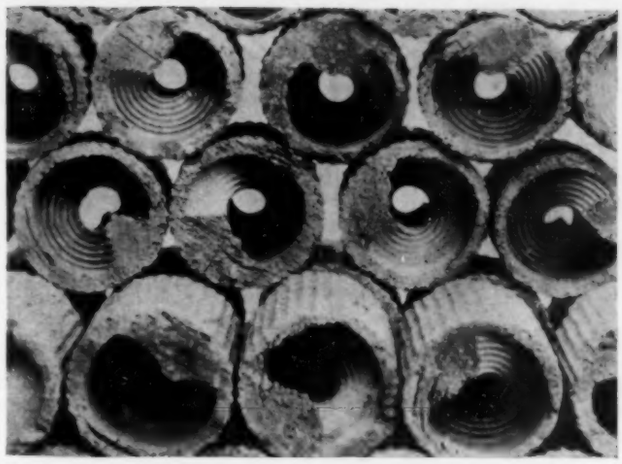


Fig. 2—Spiral Rings Packed, Showing Center Void

The tower designer should scrutinize the chemical stoneware shapes he intends to use, both for chemical composition and for physical structure and mechanical strength. Ware designed for contact with acid should have a high silica content, low iron oxide and alumina, very low alkaline earths, and not more than a trace of alkalis. It should be thoroughly vitrified, non-absorbent, and as impermeable to acids as possible. It should have high compressive strength, low coefficient of expansion, and should be free from defects of all kinds.

Bricks for tower construction are produced in a number of standard forms, but there appears to be in the United States no product equivalent to Obsidianite, manufactured by Charles Davison & Co., Ltd., Buckley, England. This material is supplied not only in the form of bricks, tiles and packing units but also in blocks of various shapes and sizes, up to 300 lb. in weight, which can be fitted together for the construction of the entablature of chemical towers (*i.e.*, the lower part of the tower, including linings, gas inlet ports and arches, up to the top of the grid). Such shapes are fitted together without cement or mortar prior to shipment by the manufacturer and are mason-dressed if necessary. Each block is then numbered so that it can readily be assembled on the job, following a correspondingly numbered erection plan. Table I lists the chemical composition and some of the physical characteristics of Obsidianite in comparison with average American chemical stoneware, an American "acid brick," and another English chemical brick known as Metalline.

Chemical brick, tile, tower packers, and the like should not be accepted merely on the strength of chemical analysis but should be subjected to severe practical tests as well. Such tests may include submersion of specimens in hot Glover-tower discharge acid for a definite

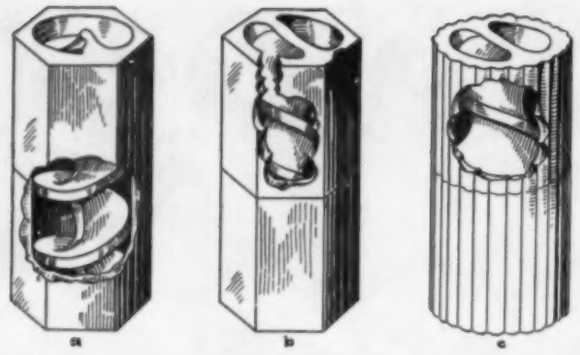


Fig. 3—Helical Packers; *(a)* Single-Spiral Hexahelix Blocks; *(b)* Double-Spiral Hexahelix Blocks; *(c)* Double Spiral Cyclohelix Blocks

length of time; and treatment of sized fragments with 60-deg. Bé. sulphuric acid, kept at boiling temperature with the help of a reflux condenser in the flask containing the sample. Tests should be continuous for 48 hours. The relative value of various wares may then be determined by comparison of the percentages dissolved or of the screen analyses of the materials before and after treatment. The preparation of standardized tests and specifications for chemical brick, tile, and so on is a subject meriting the attention of the American Institute of Chemical Engineers and the American Society for Testing Materials.

A comprehensive survey of a great many varieties of tower packing has been published by Charles H. Butcher ("Acidproof Packing for Absorption Towers," *The Industrial Chemist and Chemical Manufacturer* (Brit.), November, 1928, 446), giving data regarding the relative value of individual shapes so far as surface area and free volume are concerned. A comparison of tower packings on these two bases alone is, of course, inadequate, as Butcher himself recognizes.

In reaching a decision as to the kind of packing to place in a tower, at least 11 characteristics of the available packings should be considered:

1. Effective (*i.e.*, wetted) surface area per cubic foot of packed tower space.
2. Free volume (space unoccupied by the substance of the packing material) per cubic foot of packed space.
3. Free area (area unoccupied by the substance of the packing material) per square foot of cross-sectional tower area. This is the area available for the passage of gas at the junction of adjacent tiers of packing.
4. Resistance to gas flow (expressed as the pressure required to produce a given gas velocity through the packing).
5. Tendency to accumulate particles of solids brought into the tower by the gases or liquids.
6. Weight of the packing per cubic foot.
7. Duration of contact between gas and liquid.
8. Stability of position, as packed (degree of side-thrust against tower walls).
9. Durability in the presence of the fluids handled.
10. Tendency toward segregation of flowing gas in open spaces and of liquids on surface areas, thus hindering direct contact of gases and liquids.
11. Cost per square foot of effective surface area and per cubic foot of packed tower space as stacked.

For many years manufactured forms of packing have been replacing lumps of quartz and coke, which were the early packing materials, and to some extent brick and tile checkerwork as well. To mention only a few of the manufactured forms, we have in the United States, Raschig rings (small hollow cylinders, usually about 1 in. long by 1 in. in outside diameter); straight and curved partition rings (Fig. 1*a*); hollow square partitioned tile and tubes (Fig. 1*b*); hollow balls (Fig. 1*c*); "spiral rings" (Fig. 2); and various forms of helical-vane blocks such as those illustrated in Fig. 3. In Europe, well-known shapes include the Nielson "propeller," of which there are two varieties; the Obsidianite packer (Fig. 1*d*). and the Mackenzie-Gibson tile. These various shapes have been designed mainly to afford greater surface area and greater interstitial space than is possible with large solid bodies like bricks or lumps of coke or quartz.

No form of packing can take first place from the standpoint of all of the 11 criteria listed above. The tower designer should weigh the advantages clearly demonstrable for the various shapes available, and make his choice on the basis of a preponderance of advantages offered by any one packing for the purpose in hand.

A number of characteristics of several different kinds and sizes of manufactured packings, as compared with similar data for lumps of quartz and coke, have been published by Zeisberg (*Trans Am. Inst. Chem. Eng.*, **12**, Part 2 (1919), 231), who reported an experimental study on the resistance to gas flow, the effective surface area, and the free volume of packing. He presented a method of determining and expressing numerically the relative advantages offered by the manufactured forms tested in these three particulars. Of his several conclusions those more interesting here are: (1) resistance to gas flow increases rapidly with decrease in the size of the packing unit; and (2) for any given size of packing, the manufactured shapes afford much more surface and greater free (unoccupied) volume, and present much less resistance to gas flow than lumps of material like quartz or coke.

He showed, for instance, that 1-in. Raschig rings, dumped in, offer a resistance about 5½ times as great as

Table I—Chemical Analyses and Physical Characteristics of Acid-Resisting Ceramic Materials

	Obsidianite,[1] Per Cent	Average American Chemical Stoneware,[2] Per Cent	An American "Acid Brick,"[3] Per Cent	Metalline[4] Per Cent
Silica	79.1	73.23	61.7	63.01
Alumina	15.2	22.27	32.7	25.95
Ferric oxide	3.5	0.58	2.8	6.49
Alkaline earths	1.5	0.58	0.7	1.23
Alkalis	Trace	3.44	1.8	2.57
Water and organic matter	0.7	0.06	Nil	0.9
Absorption	0.31	.....	2 to 5	.....
Fusing point, deg. F.	2,500	.....	.....	.....

[1]Published by the manufacturers.
[2]Kingsburg, *loc. cit.*
[3]Communication from the manufacturers.
[4]*Chem. Trade J.* (Brit.), **10**, 46.

Table II—Data on Miscellaneous Packings[1]

	Size, Inches	Units Per Cu.Ft.	Weight Per Cu.Ft. Pounds	Free Volume Per Cent	Exposed Surface Sq.Ft. Per Cu.Ft.
Coke, dumped	6	....	26	57	5.5
Coke, dumped	3	....	30	50	12.0
Quartz, dumped	6	....	87	48	6.3
Quartz, dumped	3	....	92	43	13.7
Brick, 9-in. centers[2]	9x4½x2½	5½	48	72	3.7
Brick, 4½-in. centers[2]	9x4½x2½	9½	81	45	6.7
Obsidianite packers[3]	9x4½x3	14½	64	59	18.0
Nielson radial propellers[3]	6x6	13	40	78	16.0
Nielson hollow propellers[3]	6x6	12	34	80	17.5
Nielson hollow propellers[3]	4x4	40	29	80	25.0
Spiral rings[3]	6x6	8	53	58	15.0
Spiral rings[3]	3x3	64	53	64	29.0
Hollow cylinders[3]	4x3	38	52	64	20.0
Hollow cylinders[3]	3½x3½	61	28	80	26.0
Hollow balls	2½	140	52	33	19.0

[1]Butcher, "Acidproof Packings for Absorption Towers," *loc. cit.*
[2]Laid on edge.
[3]Stacked.

that of 3-in. spiral rings dumped. He showed also that the resistance of 3-in. quartz lumps is more than twice as great as that of 3-in. spiral rings or partition rings.

Jorgenson (*Chem. & Met.*, April 27, 1921) presented an empirical formula for calculating the effectiveness of tower packing. This, however, is based on only two of our 11 criteria. This expression may be given as

$$E = 0.3706\,sv$$

where E is the relative efficiency of the packing, s is the effective packing area per cubic foot of packed space, and v is the free volume per cubic foot of packed space. The constant was so chosen as to make the result a comparison with 9-in. brick checkerwork on 9-in. centers. Obviously, no such simple method of calculation can approach in value the testing method of Zeisberg.

Jorgenson points out that the presence of unequal gas passages in a packed tower will result in channeling or segregation, the gases following the larger passages and the liquid, the smaller passages. It is to channeling of this sort, which prevents the desired contact between flowing gas and liquid, that Jorgenson attributes the inefficiency of coke and quartz packings. Unfortunately, certain manufactured packings also appear to favor segregation, although less seriously, perhaps, than quartz and coke. Hollow balls, for example, or cylindrical units with a spiral vane against the inside of the wall and with a void center, seem to favor segregation. Cylinders, when stacked in a tower, leave voids between units and, as illustrated in Fig. 2, favor flow of gas in places where the spiral vane is not, at the same time favoring flow of liquid, for the most part, on the spiral vane, where the bulk of the flowing gas is not.

An article which appeared on page 105 of the February, 1929, issue of *Chem. & Met.* described a hexagonal packing block designed by the writer to avoid segregation of flowing gas and liquid in a packed tower. As first put on the market, this block contained a helical vane of width equal to the full length of the radius. This unit was first manufactured by Maurice A. Knight under the trade name of Hexahelix. It is shown in Fig. 3*a*. It was recognized that a double vane extending entirely across the block would have advantages, but mechanical difficulties in constructing a suitable extruding machine prevented the production of such a block

Table III—Data on Hexahelix Blocks[1]

(Stacked in vertical alignment, non-staggered)

	Size, Inches	Units Per Cu.Ft.	Weight Per Cu.Ft. Pounds	Free Volume, Per Cent	Exposed Surface, Sq.Ft. Per Cu.Ft.	Free Space, Per Cent Area	Material Volume Per Unit, Cu.In.
Single spiral	3½x3	63	86	43	42	53	15.74
	4 x4	31	82	45	33	55	30.67
	6 x6	9	70	53	22	60	90.28
Double spiral	3½x3	63	84	44	44	50	15.39
	4 x4	31	79	47	35	52	29.48
	6 x6	9	69	54	23	57	89.00

[1]Data from U. S. Stoneware Co.

Table IV—Curved Partition Rings and Cyclohelix Blocks[1]

	Size, Inches	Units Per Cu.Ft.		Weight Per Cu.Ft., Pounds		Free Volume, Per Cent		Exposed Surface Sq.Ft. Per Cu.Ft.		Free Space, Per Cent Area		Material Volume Per Unit Cu.In.
Type of stacking[2]	....	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	.....
Partition rings...	3 x3	74	64	79	69	47	54	41	35	47	54	12.47
	4 x3	41	36	81	71	46	52	31	27	46	53	22.82
	4 x4	31	27	81	71	45	52	30	26	46	53	30.42
	6 x4	14	12	73	62	51	58	22	19	51	58	60.21
	6 x6	9	8	70	52	53	58	20	18	51	58	90.32
Cyclohelix blocks (Single spiral)	3½x3	63	54	67	57	55	62	42	36	66	71	12.32
	4 x4	31	27	64	56	57	63	34	30	65	70	24.02
	6 x6	9	8	54	48	64	68	22	20	71	74	69.20
Cyclohelix blocks (Double spiral)	3½x3	63	54	65	56	56	63	44	37	63	68	11.97
	4 x4	31	27	61	53	59	64	35	31	62	67	22.83
	6 x6	9	8	54	48	64	68	23	21	68	71	69.76

[1]Data from U. S. Stoneware Co.
[2]Types *a* and *b* as shown in Fig. 4.

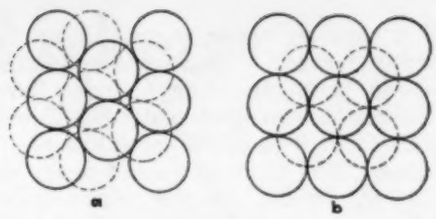


Fig. 4—Stacking Methods for Staggering Cylindrical Packings; *(a)* Each unit rests on three below; *(b)* Each unit rests on four below

until more recently. The double-spiraled Hexahelix block shown in Fig. 3*b* is now obtainable from the U. S. Stoneware Co., which also produces two modified blocks having cylindrical instead of hexagonal perimeters but using the full-radius and double full-radius spiral. It is the writer's belief that the six-sided Hexahelix block is preferable to the cylindrical form for most purposes; but the latter shape is preferred for special uses by some users of tower packing. The cylindrical blocks are known as the Cyclohelix and appear in the double spiral form in Fig. 3*c*.

The Hexahelix block is so constructed that six units can be fitted exactly around any individual unit, leaving no voids between units. The design of vane is such that there are no straight-flow passages whatsoever in the packed space. This positively prevents segregation of the flowing liquid and the gas, promoting direct contact. Furthermore, the design of vane in all forms of Hexahelix and Cyclohelix blocks is such that both upper and lower surfaces are wetted. This doubles the effective vane surface as compared with blocks having a spiral vane capable of being wetted on only one side. The blocks have been designed for durability under heavy duty such as for packing in Glover and Gay-Lussac towers and the like, and a thickness of $\frac{5}{16}$ in. has been adopted as the minimum for walls and vanes.

Manufactured forms of packing may be placed in a tower in a variety of different ways. Raschig rings usually, and partition rings and spiral rings occasionally, are dumped in at random. Usually packing units are arranged in the tower in some regular manner, as in horizontal courses or tiers. It is common practice to stack cylindrical rings in staggered formation, as is indicated in Fig. 4. It will be noted that there are two methods: *a*, in which each unit in a higher tier rests on parts of three units; and *b*, on parts of four units. Both types of Nielson propeller, the Obsidianite packer, hollow balls, and a number of other manufactured forms are especially designed to be stacked in staggered formation.

Hexahelix blocks, on the contrary, are designed to be stacked accurately around one another in horizontal tiers and on top of one another in columns, vertically aligned. Stacked in this way, stability of the packing and the absence of side-thrust against the side walls of the tower are obtained. The longer lengths are recommended as requiring less labor for installation and as being more effective when installed.

For ready comparison of some of the principal physical characteristics of manufactured packing materials, Tables II to IV are presented, giving data on a wide variety of shapes.

With the tower built and the packing in place, it remains only to install the tower top and the liquid feeding and distributing devices and to connect the various liquid pipes and gas flues. With the successful development of centrifugal pumps for corrosive liquids (now

considered a necessary tower accessory) top feed tanks are frequently omitted. Improved liquid distributors such as splash plates and spray nozzles have largely replaced the cumbersome and spider-like liquid distributing systems formerly used for large towers.

In conclusion, the needs of packed-tower users may be summarized briefly. Better chemical - stoneware application can come only from closer cooperation between the user and the stoneware manufacturer. For tower construction stoneware of unquestioned durability should become available in massive shapes. To this end, standard specifications and methods of testing chemical stoneware are highly desirable. Similarly, acidproof cements should be studied and specifications and methods of testing adopted. Finally, it is desirable that extensive experimental tests be made to determine the relative merits of all important packing shapes and sizes.

▼ ▼

Volume and Temperature Of Gas Mixtures

By EVALD ANDERSON
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CHEMICAL and plant engineers often have occasion to calculate the volume of mixtures of two or more volumes of gases at different temperatures. For example, nearly all the stack gases are such mixtures of hot furnace gases with cold air. The most common method in such cases usually is to calculate the weight of the two gases and then the temperature of the mixture, after which the volume of this mixture is readily determined.

Having followed this procedure a number of times, the writer came to the conclusion that the final gas volume was merely the exact sum of the volumes of the original gases. Thus with V_1 the volume of a gas at the temperature T_1, and V_2 that of another gas at temperature T_2, the final volume, V_3, resulting from mixing the two gases was always V_1+V_2, so long as the pressure, P, remained unchanged and the specific heat was the same for the two gases over the temperature range encountered.

Although trial calculations thus indicated that this relation was true and such a relationship also seemed logical from considerations of the gas laws, it proved difficult to demonstrate this rigorously until Arthur P. Knight, head of the patent department of the Western Precipitation Co., suggested the following simple proof.

Let V_1,P,T_1, and N_1 be the volume, pressure, absolute temperature and mass of gas (1), and V_2,P,T_2 and N_2 the same quantities for gas (2), while V_3,P,T_3 and N_3 are the volume, pressure, temperature and mass of the combined gases. Further, let S be the specific heat of both the original gases and final mixture, this specific heat being taken as constant. This assumption, naturally, is not strictly correct, but it is sufficiently accurate for most cases.

Then it follows from the gas laws that the following relations hold:

$$PV_1 = N_1RT_1 \quad (1)$$

$$PV_2 = N_2RT_2 \quad (2)$$

$$PV_3 = N_3RT_3 \quad (3)$$

Since the heat given up by the hot gas (1) in cooling to the final temperature, T_3, is the same as that absorbed by the cool gas (2) in warming up to T_3, it follows that:

$$N_1S\ (T_1-T_3) = N_2S\ (T_3-T_2) \quad (4)$$

or

$$N_1\ (T_1-T_3)\ = N_2\ (T_3-T_2) \quad (5)$$

and by transposition

$$N_1T_1+N_2T_2\ = T_3\ (N_1+N_2) \quad (6)$$

By adding both sides of equations (1) and (2), bearing in mind that the pressure P is the same in all cases, we obtain

$$P\ (V_1+V_2) = R\ (N_1T_1+N_2T_2) \quad (7)$$

Comparing equations (7) and (6) it is evident we can rewrite equation (7) as follows:

$$P\ (V_1+V_2) = R\ (N_1+N_2)\ T_3 \quad (8)$$

and since

$$N_1+N_2 = N_3$$

we can also write

$$P\ (V_1+V_2) = N_3RT_3 \quad (9)$$

It then follows from (9) and (3) that

$$P\ (V_1+V_2) = PV_3 \quad (10)$$

or

$$V_3 = V_1+V_2 \qquad \text{Q.E.D.} \quad (11)$$

It is thus seen that if we wish to know the volume resulting from mixing two volumes of gas at, say, atmospheric pressure and different temperatures, we have merely to add together the original volumes. Thus if we have, let us say, 1,000 c.f.m. of furnace gases at our temperature T_1 and to these we add 500 c.f.m. of outside air, the resulting volume will be 1,500 c.f.m., so long as the specific heat of the furnace gas, air and mixture can be assumed the same. The belief sometimes held, that one can reduce the volume of hot gases by an admixture of cold air or gas, is thus entirely unfounded.

It is often required also to know the temperature, T_3, of the final mixture. Ordinarily this is calculated from equation (6), since here

$$T_3 = \frac{N_1T_1+N_2T_2}{N_1+N_2} \quad (12)$$

Here obviously N may either be the weight of the gases or their volumes at standard or equal temperatures. The volumes at standard temperature, $(V_1)_o$ and $(V_2)_o$, are obtained from the simple relations:

$$(V_1)_o = V_1\frac{T_o}{T_1} \quad (13)$$

and

$$(V_2)_o = V_2\frac{T_o}{T_2} \quad (14)$$

where T_o is 273 or 491 for T_1 and T_2 expressed in absolute Centigrade or Fahrenheit degrees respectively.

Combining equations (12), (13) and (14), we obtain

$$T_3 = \frac{(V_1+V_2)\ T_1T_2}{V_1T_2+V_2T_1} \quad (15)$$

Expressing temperatures in degrees Absolute, we thus have the following simple expressions for the temperature and volume of mixed gases at constant pressure, and constant specific heat:

$$T_3 = \frac{(V_1+V_2)\ T_1T_2}{V_1T_2+V_2T_1}$$

$$V_3 = V_1+V_2$$

Extending Leather Markets Through Shredding

By CHANDLER D. INGERSOLL
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HISTORY has honored the leather industry with having one of the oldest arts known to mankind: the tanning of hides. It is somewhat surprising, therefore, to find this industry with a fairly large volume of waste product for which only a moderate utilization has been found. The answer to this rather anomalous condition lies in the fact that for some centuries leather was the only tough cushioning material readily available that could be worked and molded. The waste strips and pieces from harness, belting, shoe, and other manufactures thus found their way to women's heel lifts, washers, snugging strips, vibration absorbing pads, cushion casters, and a whole multitude of small-piece utilizations which kept reducing the ultimate quantity of waste to a point quite satisfactory to the industry; while the erstwhile custom shoemaker of the last and previous centuries developed this thrift in the cutting of his leather to a degree that would gladden the heart of the proverbial Scotchman.

Nevertheless, there have been certain classic utilizations of scrap leather which have had more or less of a heyday and are either now relegated to the scrap heap called history or are holding on to existence by the tenuous bonds of habit and tradition. Among these might be mentioned the old "Pot Process" for making prussiate of potash by lixiviating leather scrap, old shoes, wool waste, and other protein refuse with potash in the presence of iron. The yields from this process were small, however, and it slowly gave way to the more efficient chemical syntheses of the present day.

Classic is the use of scrap leather in the compounding of fertilizers to build up their nitrogen content. Here the leather is ground and treated with some agent such as steam or acid to render the nitrogen more quickly available as a plant food. It is of interest to note in this regard that only vegetable-tanned leather is suited to this purpose, as the scrap from chrome tannages has been claimed to act as a poison and exert definite inhibitions to plant growth.*

A utilization of doubtful economics has been the burning of scrap leather under boilers for what fuel value is in the material. This should be regarded principally as a means of disposal, for it is quite as customary to find the scrap burned on the "dump" to get rid of it.

It is only in recent years that we find waste leather being discussed more and more as an industrial problem. This is due in fair measure to the fact that the industrialization of the shoe and leather industries in the last half century into larger and larger units, with machinery taking the place of handcraft, has naturally led to an ever-increasing quantity of waste. Like so many other industries that have gone the way of mass production, the savings have been effected primarily in labor, the increase in material waste being a minor factor in comparison. We may think of scrap leather, therefore, as a relatively new waste product, in spite of the age of the tanning and leather industries.

In regard to the quantity of scrap available in the United States, there are no definite figures available. However, on the basis of the scrap produced at subsidiary sole-cutting plants of the United States Leather Co. and of computations based on leather-soled shoe production, the waste scrap leather produced in the United States amounts to several thousand tons annually from sole-cutters, shoe manufacturers, shoe repair shops, belting manufacturers, and other leather-working establishments. There is practically no market for this scrap at present, its value running from $2 to $5 per ton.

Naturally, the possible utilization of this growing waste pile has received notice from time to time and various efforts have been made to turn a loss into a profit. It is no surprise, therefore, to find various industrial attempts with scrap leather as the raw material. In an industry so traditionally secretive as the leather industry, no exhaustive résumé of these efforts can even be attempted, but the following outline taken from the pages of our scientific and trade literature, will give a fair perspective of the trend of efforts made to date.

We have mentioned above the use of leather in the old "Pot Process" for the manufacture of prussiates and also its continuing use in the compounding of fertilizers.

Starting with the War, we find a renewed interest in the subject, especially in England, which has carried through to the present day and perhaps will prove the impetus which will finally carry these efforts in the utilization of scrap leather to a successful conclusion.

Lamb (*J. Soc. Chem. Ind.* **36**, 1917, 986) presented a broad picture of the work then under way by the British government and dwelt at some length on a patent by S. Brough for the incorporation of leather chips in macadam road compositions to the amount of 5 per cent for heavy traffic and 10 per cent for light traffic conditions. A feature claimed for these roads was their added resilience and traction. He reviews briefly in turn: char, ammonium sulphate, grease, fertilizer, leather board, washers, chain-link mats, leather pulp and powder, cyanides, glue and size. A shorter statement of the work of the British government is given by Laurie (*Chem. Trade J.*, **64**, 1919, 454), principally with reference to the use of scrap leather for fertilizers and glue.

In this country, Michelman (*J. Ind. Eng. Chem.*, **17**, 1925, 247; U.S.P. 1,572,552) has endeavored to show that on destructive distillation scrap leather yields pyrrolles and pyrracoll products, which should find use in the manufacture of perfumes and alkaloids.

Of more interest to us at present, however, is the sequence of patents (U.S.P. 1,234,315, 1,235,043, 1,277,322, 1,386,711, 1,302,512, 1,302,513, 1,312,682,

J. Soc. Leather Tr. Chem., **1**, 117-8 (1917); U.S.P. 1,255,643, 1,268,683. *Am. Fertilizer*, **47**, 24-6 (1917); **57**, 31-3 (1922); B.P. 147,798. *J. Am. Leather Chem. Assn.*, **19**, 11-4 (1924).

1,469,563, 1,541,922) showing a continuing interest in the idea of successfully producing a composite leather material from shredded leather, both with and without the incorporation of various rag stocks, etc. Of particular note are U.S.P. 1,302,512 (Clapp) and U.S.P. 1,541,922 (Chaney) for making gun-wad felt and leatherboard felt, respectively. Further, this interest in the manufacture of satisfactory sheet board and molded products has gone beyond the patent literature into practice, being evidenced by a succession of industries which have, with greater or less success, ground up scrap leather and formed this material into a sheet for use in the manufacture of mats, leather belts, shoe soles, pulley blocks, and so on.

There is a very natural cause behind this continued interest in shredded leather: to wit, the peculiar and individual properties of the material. A study of the matter has prompted the writer to set down these properties in such brief outline as will permit a better appreciation of the possibilities of the material.

We all know the fibrous quality of leather, which forms one of its distinctive and most important characteristics. This typical architecture might well be called the keystone of leather's usefulness, as it accounts for practically all the qualities enumerated below that give leather its place of value in our civilization.

A study of microphotographs of hide and leather cross-sections readily shows that this special fibrous architecture can be traced back to the original hide, where nature has built it up to perform the physiological functions of the skin. Due to the tanning operation, wherein turgidity of the cell structure (plumpness of the hide) is controlled and chemical combination of the tanning materials with the hide substance takes place, the fiber structure becomes somewhat more accentuated.

Other properties also become changed in the tanning operation and it might be well to mention these briefly. Whereas live skin falls readily under the classification of elastic materials which exhibit elastic stretch and recovery, this undergoes a marked change in tanning—leather has a very low elastic limit. It exhibits a tendency to develop a permanent set under too great a load, which breaks down, however, under continued stress. The leather is then stretched again to its new elastic limit, takes up a new "permanent" set and the cycle thus keeps repeating itself. From this point of view, leather belting specifications might well be based on the load resistance offered by the belt against fatigue (breakdown) of the "permanent" set.

Further, leather does not shrink (relatively) and harden on drying as does hide, the fibers maintaining their separate space arrangement and not exhibiting the strong tendencies of their forebears to coalesce and compact when water is given up.

Finally, it seems hardly necessary to mention that with proper tanning the high putrescibility of the hide disappears and we have a fibrous substance resistant to bacterial decomposition.

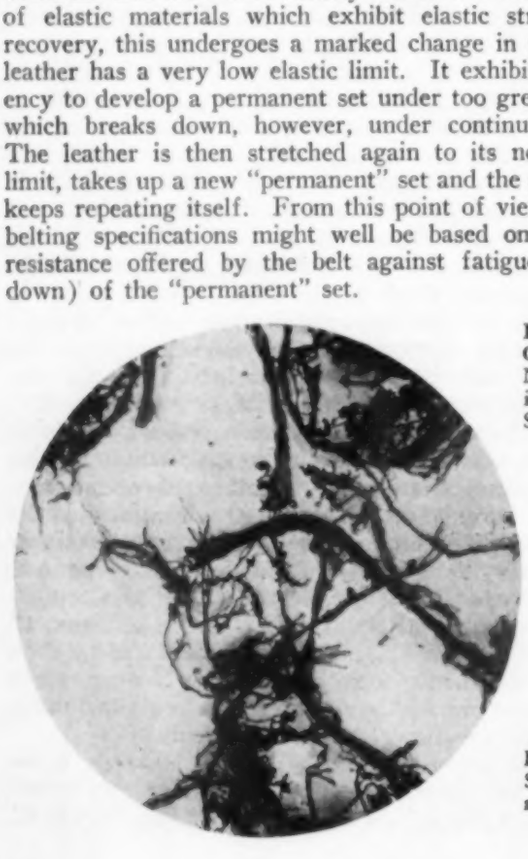
This résumé of the broad effects of tanning shows us quite clearly that in leather we have produced a well-defined fibrous body which can be subjected to a large variety of torsional and mechanical strains within definable limits without losing the characteristics with which its fibrous quality endows it. Our point at hand in the utilization of waste scrap leather, therefore, is to separate or untangle these fibers into a state where they can be worked and relaid into a new sheet which will have, as far as possible, the qualities originally inherent in the leather.

This disentanglement of the fibers we have called shredding, to denote the difference from simple grinding. In the latter case, the product is merely finely divided as a powder; in the first instance we are working toward a product with as long a fiber as possible.

Various attempts to shred leather have been made from time to time, both in the wet and dry state, but due to one reason or another the product obtained was not the nice fiber structure desired but usually part fiber, part cut fiber lumps and part powder. The most successful fiber products the writer has obtained to date have invariably been from a high-velocity impact of small pieces against an air cushion such as is obtained in a hammer mill. In this way the fibers unravel themselves and a product is obtained which seems in every way suitable for the purpose intended.

We can now look at these fibers in their "shredded" state with the above perspective of their origins.

First we find that they are fine and of great pliability. Due to their structure, they show a strong tendency to attach themselves to one another or to any surface which presents an opportunity for them to entangle their "surface" fibers. (Note the fuzzy projections along the main fiber pieces as shown in the photomicrographs.) This self-entangling tendency is so strong that a shredded leather mass will mat into balls with simple hand pressure; under hydraulic pressure the shredded leather can be compressed into hard, firm blocks without any binder. The fibers will attach themselves so firmly



Left: Shredded Leather Fibers Completely Disentangled; Note Fine Tendrils Branching Off From Main Fiber Stems (Magnification, 50X)

Right: Shredded Leather Showing Extreme Entanglement of Fibers in the Mass (Magnification, 50X)

throughout the mass that the molded piece will maintain its shape, dimensions, resiliency, and sharpness of outlines.

On the other hand, we find shredded leather extremely light, especially so in bulk, due to its structure and air content. In dry-molding operations, therefore, a wide range of density of finished product can be obtained, depending on the molding pressure used.

Shredded leather has a high moisture-absorbing power, about the same order as wool. In fact, the relation between the moisture equilibrium in leather and the relative humidity of the air readily suggests the use of shredded leather as a humidity buffer. This phase of the subject is yet to be investigated, however, and little can be said about it, except that the growing refinements in our manufacturing and storing practices have indicated the wider and wider use of humidity control in industry.

The writer wishes to answer two questions at this point which seem to be the first to present themselves in the minds of many people. These questions always concern qualities of a commodity which, for one reason or another, have been broadly written into specifications. They remind me of a nursery blackboard my children received one Christmas. In gold and red, prominently placed on the top strip of the frame, was a seal with the words "Guaranteed Absolutely Germproof." Now it might be that germproofness is a desirable quality to have in nursery blackboards, but I can name several others which I would place far ahead of it on the list: Such qualities, for example, as impact-proof, non-shatterable and non-upsettable on baby brother's trusting head. Whether the blackboard ever gave sanctuary to a wayward germ, I cannot tell, for our germproof blackboard quickly developed a bad case of "rickets" and its usefulness came to an end.

And so we find the broad specifications of "fireproof" and "moistureproof" spread generously through requirements for industrial commodities and often given greater stress than the particular quality called for by the use for which the item is intended. I would point out here, therefore, that leather is not fireproof but will support a feeble combustion under certain conditions when ignited. Also, it absorbs moisture and gives it up again in accordance with surrounding conditions.

Important Uses Indicated

The qualities of shredded leather, as far as it has been tested, show its ready adaptation to the several uses enumerated below. It has marked sound-absorbing properties, which, coupled with its moldability, recommend its consideration in this field. In low-temperature insulation it should prove particularly effective in inclosed walls or partitions, on account of the high air-volume content of the bulk material. It has been successfully subjected to molding operations, both with and without binding agents, and shows a product of high strength, but to which the fiber of the leather has given resiliency. Its fibrous nature has naturally suggested its use in wallboard and leather-paper, and thus far our work has shown it will conform well to regular practice in wallboard and paper manufacture. Its use in linoleum also has been suggested.

It is natural in a new product of this sort that means of testing it should have been sought. Thus far the principal tests comprise a "fiber length" test, freeness test (taken from paper industry), and tensile- and breaking-strength tests of molded pieces, both with and without binder. (In connection with the first test it is to be noted that fiber length is not actually measured, but the test is indicative of the fiber length.) It seems evident at this time that the development of shredded leather as a commodity will bring with it a series of tests for each separate use to which it will be put.

In summary, it is my belief that shredded leather has already given promise of a wide field of usefulness, and that its future development will amply justify the present interest in it.

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Shipping Pine Gum In Tank Cars

By ARTHUR R. HITCH
Chemical Director, Gillican-Chipley Co.
Savannah, Ga.

Most of the difficulties encountered in transportation of large quantities of crude pine gum varying in grade from "virgin" to "very poor" have been overcome by the development of a tank car with special accessory equipment. If the interior surface of the car is properly covered with varnish, degrading of the gum is prevented. Worth-while economy in time, labor, and spillage at the central refinery can be effected by shipping in this type of container. And a saving in freight charges of as much as 70c. per barrel can be effected if shipment is made in tank cars instead of barrels.

IT HAS been common practice to ship crude pine gum from producing areas to the still or refinery in either wood or galvanized-iron barrels. Where the still is located immediately within the producing area, barrels of crude gum usually are hauled to the still by horse and wagon or small auto trucks. Where the still or refinery is a considerable distance from the gum-producing areas it is found necessary to ship the barrels of gum by railroad or large auto trucks. This method of handling necessitates high freight charges, since each barrel weighs approximately 22 per cent of the gross weight of a barrel of gum and the freight rate on the returned empty barrels is considerably higher than that of the crude gum.

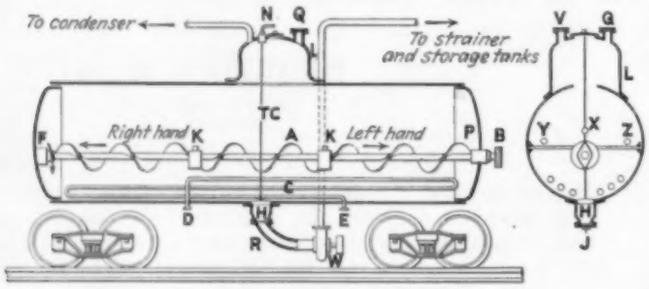
In order to eliminate these freight charges and effect considerable saving in waste of gum by spillage and labor of handling barrels at the central refinery, a tank car of special design was constructed. A sketch of this car is given in an accompanying illustration and a description follows.

This special tank car has been put into operation by the writer and has served in a successful experimental way to transport crude pine gum of various grades to the central pine-gum refinery of the Pineland Products Co., Savannah, Ga., a subsidiary of the Downing Co., Brunswick.

It is an ordinary 7,000-gal. turpentine tank car, approximately 30 ft. long and 7 ft. in diameter, equipped with horizontal 2-in. steam coils, *C*, and provided with a special horizontal agitator, *A*, of the helicoid type.

This agitator is supported in the center by the two bearings *K*, and at ends by bearings *F* and *P*; a stuffing box is provided at *P*. The agitator is arranged so that one-half of the flights have a thrust toward the right end and the others toward the left end of the tank. To the outer end of the agitator shaft is affixed a sprocket wheel which is attached to a set of gear wheels. The steam coils *C* are located approximately 4 in. from the shell of the tank and spaced 6 in. apart. The agitator has a diameter of 2 ft. and is placed so that the edge of the circle described by the flights is 8 in. from the bottom of the shell of the tank. Spaced around the upper arc described by the agitator at points *X*, *Y* and *Z* are additional 2-in. steam pipes running parallel to the agitator.

Along the railroad siding in the gum-collecting area, was built an elevated platform approximately 8 ft. square and 3 ft. higher than the dome of the tank car.



Tank Car for Use in Shipping Pine Gum

A ramp was constructed from the ground to this platform at such an angle that the barrels of gum could easily be rolled up this incline by two men. A metal-lined wooden trough was extended from the platform to the manhole in the car dome, into which the gum in the barrels was dumped. From the trough it flowed or was pushed into the tank car. In this trial 120 bbl. (55 gal.) of gum was taken as a carload. The average time required to load a car was approximately 8 hours. The cover was put on and the car was shipped to the central refinery of the Pineland plant at Savannah for processing into turpentine and rosin.

The unloading of the tank car was carried out as follows: The 8-in. nipple cap *J* was removed and a pipe fastened on, connecting the nipple with the 4½-in. centrifugal pump *W*. This connecting pipe, which tapered uniformly from 8 in. to 4½ in., was so made that it had a gradual bend instead of one that would form a right-angle. The plant steam line was connected at *E* to the heating coils and a steam trap coupled to *D*. The sprocket wheel *B* was connected through gearing to an electric motor and the helicoid agitator *A* turned at a rate of approximately 80 r.p.m. To *V* was connected a 2-in. vapor line leading to a condenser for use in collecting the turpentine which might distill over during the heating. The operation of heating and agitating was carried on until all of the gum had become entirely melted. The time required varied greatly with the kind and character of the gum handled. Good virgin gum required approximately 1½ hours' heating at 194 deg. F., while poor-grade gum and that containing much scrap and trash required from two to six hours' heating at the same temperature. Virgin gum needed no turpentine for thinning, but the poor-grade gum usually required 10 to 15 per cent by weight to obtain best results in the melting and straining operations. After the gum was thoroughly melted, seat valve *H* was opened, rotary pump *W* started, and the contents of the car pumped to a strainer for removing trash, then to storage tanks, from which it was drawn to the steam still for processing into turpentine and rosin.

Tank-Car System Shows Large Saving

Previous to the use of the tank-car system at our gum refinery, barrels of gum were unloaded from box cars or trucks, elevated to the charging floor, beheaded, the gum charged into a mixer holding 10 to 12 bbl. (500 to 600 gal.), thoroughly melted and strained. The empty barrels were then headed up and loaded on box cars and returned to the gum-collecting camps. This operation for 120 bbl. usually required two men at least 12 hours. The normal time for unloading a tank car of medium-grade gum was two hours for melting and 1¼ hours for pumping and straining, making a total of 3¼ hours, one man being used for the operation. Thus, it can be seen that a large saving in time and labor can be had by using the tank-car system of handling crude pine gum.

Various grades of gum have been used, from virgin to scrap. The analyses of these shipments showed an average dirt and trash content as follows: virgin, 1.5 per cent; medium, 3 per cent; poor, 5 per cent; and scrap, 6 per cent. Even though much of the trash was made up of rather large chips and the medium and poor-grade gums contained considerable straw as well as chips and dirt, no serious trouble was experienced in the operation. However, when mostly scrap was shipped, difficulty was experienced with the rotary pump jamming. This was found to be due not so much to the large quantity of trash present as to the nature of the chips. It is believed that if an 8-in. rotary pump were substituted for the 4½-in. pump, no trouble would result.

The first shipment was made in a tank car which had not been thoroughly cleaned of rust. This rust lowered the quality of gum from "WG" to "Mary." After the first shipment the inside of the car was treated with Bakelite varnish, and thereafter no further degradation of the gum took place.

Mention has been made of the saving in freight by shipping crude pine gum in properly constructed tank cars over that of shipping it in barrels. The figures in the accompanying table, taken from actual freight bills on gum shipped between Dorchester, S. C., and Savannah, Ga., will serve to illustrate this point.

Freight Savings From Shipping Crude Gum in Tank Cars From Dorchester, S. C., to Savannah, Ga.

Freight on 120 bbl. crude gum = 65,100 lb. gross @ 0.15 per 100 lb.	$97.65
Freight on 120 empty return barrels = 14,400 lb. @ 0.42 per 100 lb.	60.48
Total freight cost	$158.13
Freight on 120 bbl. crude gum = 49,110 lb. net @ 0.15 per 100 lb.	$73.65
Total saving in freight on 120 bbl. crude pine gum by shipping in tank cars	$84.48
Saving in freight per barrel crude gum	0.70

The Carolina Turpentine Co. at Dorchester, S. C., furnished the Pineland company during the past year approximately 2,000 bbl. of crude pine gum. If this had all been shipped in tank cars at a saving of 70c. per barrel of crude, as the figures in the table indicate, there would have been a saving in freight in one year for this company alone of $1,400.

Refractories for Work at High Temperatures

By EUGEN RYSCHKEWITZCH
Frankfurt, a.M., Germany

TEMPERATURES exceeding about 1,500 deg. C. once required the choice of either carbon or graphite as material of construction. Their many excellent properties, however, were in some cases counterbalanced by their ease of oxidation and of carbide formation with metals. This eliminated the use of carbon in many instances, *e.g.*, melting of pure metals, gas reaction without carbon interference, glass melting, and in general, working of materials that contain oxygen. Refractories based on clay were developed to remedy this difficulty, but their range does not extend much above 1,600 deg. C. The solution to the difficulty had to be found in the highly refractory oxides.

Although many investigators have produced feasible results in the use of these oxides, the Deutsche Gold-und-Silber-Scheideanstalt, Frankfurt, has expanded on this work with a systematic effort to increase their availability and applicability. For, unlike clay, the refractory oxides are not pronouncedly plastic in themselves, but have to be subjected to a suitable preliminary treatment. Such treatment consists of choosing the right size of grain, proper addition of electrolyte, admixture of protective colloid, favorable hydrogen-ion concentration, and so on.

Commercial High Refractories

Zirconium silicate is the first in order of refractoriness to be treated here. A heavy crystalline powder, it is made moldable by addition of zirconium oxide and silica under slightly acid conditions. After molding, the pieces are burned in oxidizing atmosphere at 1,600 to 1,700 deg. C. and, according to the grain composition chosen and the degree of exposure to heat, the product varies from a porous to very dense texture. Its low coefficient of expansion gives it high resistance to quick changes of temperature. Above its refractory limit, the silicate dissociates and acts as solvent of the remaining silicate. Practical experience does not bear out claims that it can be used above 2,000 deg. C., but it can be used up to 1,750 deg. C.

Pure alumina, calcined at moderate temperatures, is fairly easily molded into articles which are burned between 1,700 and 1,950 deg. C., depending on the desired porosity. A noteworthy property is its structural strength, tests showing that even above 1,800 deg. C. no compression takes place under 2 kg. per square centimeter. Also because slag attack generally is due to the porosity of the absorbing bodies, Al_2O_3 is very resistant to slag. Its amphoteric character protects it against acid and basic materials; its great stability protects it from strongly reducing gases such as CO and H_2. This makes it the more suitable for melting all kinds of metals without danger of reaction. Finally, its great electrical resistance makes it suitable for electrical equipment.

Spinel, $MgO \cdot Al_2O_3$, similar to alumina, is slightly more basic at high temperatures than the latter. Very resistant to reducing atmospheres, it can be produced gas-tight when burned in oxidizing atmospheres over 1,800 deg. C. Its melting point is almost 100 deg. higher than alumina's, but its hardness is far less.

Beryllium oxide, with a melting point above 2,500 deg. C., must be made from very pure raw material, as impurities, even in slight quantities, materially lower its melting point. Also it is easily contaminated at high temperatures by other oxides, because of its high reducing power. This very property makes it valuable, however, for melting beryllium and its alloys, which would reduce all other oxides. Good thermal conductivity and moderate coefficient of expansion makes the material very insensitive to abrupt temperature changes.

Zirconium oxide, because of its very desirable inertness to reduction, acids and bases, is for that reason difficult to prepare. It was found best to mill a fairly highly calcined ZrO_2 with 2 to 4 per cent of $ZrCO_4$ and to mix the slightly acid mass with water, thus achieving a very good plasticity. A minute quantity of stabilizing substances are added to make the refractory volumetrically constant. Very highly burnt ZrO_2 is exceedingly resistant, basic glasses being melted in it for hours above 1,700 deg. C. without noticeable effects. It is slightly susceptible to reduction by carbon, which forms zirconium carbide at the point of contact. No smoke results, though, because the vapor pressure of the carbide is low. This refractory must be protected against rapid changes in temperature.

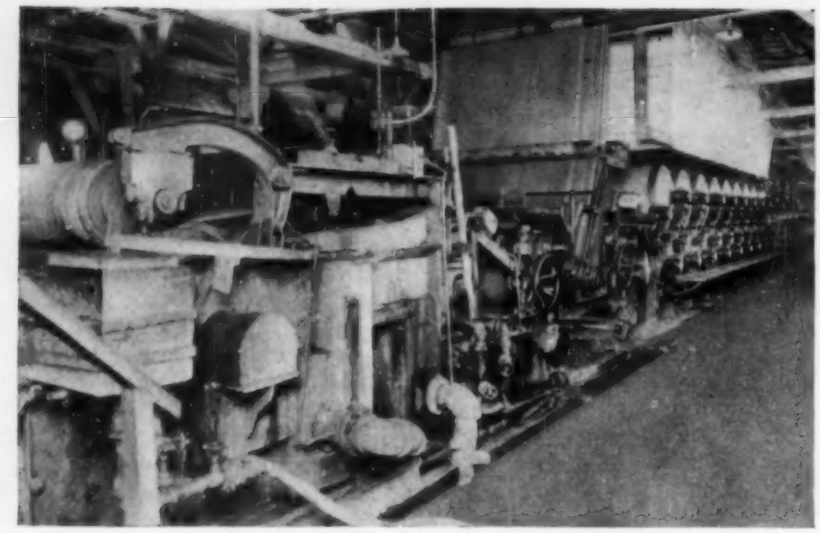
Magnesium oxide, with its melting point of about 2,800 deg. C. in a pure state, has only recently been adapted to practical refractory use. It is pronouncedly basic but less so at high temperatures. Also it can be reduced rather easily, with consequent liberation of metal vapor. However, the high temperature nowadays obtainable in oxidizing atmospheres relieves this difficulty. A high thermal coefficient of expansion makes MgO very sensitive to abrupt heating or cooling, but it can be improved by resorting to coarse structure. Bricks and vessels are, therefore, favored uses, especially because of its high softening point.

Thorium oxide has the highest melting point (about 3,000 deg. C.) of all oxides, except the comparatively rare HfO_2. Only pure oxide can be used in its manufacture without reducing its refractoriness, and sufficient density must be obtained by use of a finely grained material calcined at about 2,000 deg. C. It is extremely stable chemically, but particularly against alkaline materials. Like magnesia, it also is sensitive to very sudden changes in temperature.

Applying High Refractories

As an outgrowth of this investigation, a high-temperature furnace was developed which could make use of some of these refractories. The principle of surface combustion was so modified that the gases were combined only where they were introduced to the combustion chamber. It was so constructed that the refractory can be changed and special atmospheres introduced.

Briefly, the principle is that of combustion between the walls of two concentric cylinders, the inner one of which contains the material treated. A distance of up to 2 in. separates the walls, depending on the size of the furnace. The gas and air are supplied separately from below into the combustion chamber between the cylinders. The waste gases escape through a hole in the top of the outer cylinder into the outer chamber of the furnace. In practical trials, temperatures of 1,800 to 2,000 deg. C. are readily obtained, the exact temperature depending on the gas pressure and heating value.



Felt Machine With Vat Containing Forming Cylinder in Foreground, and Steam-Heated Cylinders in Background

The base of asphalt roofing is a heavy felt made from rags on a machine similar to that used in paper making. The felt base is saturated with asphalt and then coated on both sides with more of the same bituminous material. Crushed slate granules and mica or talc usually are imbedded in the asphalt coating to assist in giving a waterproof, fire-resisting product

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Preparing Asphalt Roofing

By J. B. NEALEY

American Gas Association
New York City

WHEN man first made a house of logs, sod did very well for a roof, but civilization has slowly progressed through different stages until today there are many types of roofs and various kinds of covering for them. One of the most satisfactory and popular of these coverings is a prepared asphalt roofing, which is marketed in roll form and in the form of shingles.

The base of prepared asphalt roofing is a heavy felt, made from rags. This rag-felt base is saturated thoroughly with asphalt and then coated on both sides with the same material. The surface which is exposed to the weather is usually covered with crushed slate granules, imbedded in the hard asphalt coating, while the under surface is covered with mica or talc. Asphalt and stone surfacings combine to give a waterproof, fire-resisting material. Many designs and colors of individual and strip shingles and roll roofings are made in a similar manner with various kinds of surfacing materials.

Rags are brought into the New Orleans plant of the Flintkote Co. from all over the world, to be converted in the felt mill into the base for roofing. The felt mill is similar to a paper mill. After the rags are cut into small pieces, they are reduced in water to a fibrous pulp state by a series of beaters. The beaten stock is carried to vats or chests, from which it is pumped to screens, which remove any unbeaten fiber. From the screens the stock flows by gravity to the forming cylinder of the felt machine. As this cylinder, which is made of a wire screen, revolves in a vat containing the stock, a sheet of felt is formed on the surface. Formation of the sheet is accomplished by pumping the water from inside of the cylinder, thereby causing water containing the stock outside of the cylinder to flow through the screen and deposit the fibrous material on the surface. As it forms, the sheet is lifted off the cylindrical screen by a long traveling conveyor made of wool. Rolls squeeze water from the sheet while it is on this conveyor, which then carries the sheet to a series of steam-heated drums, where it is dried and smoothed. After passing over these dryers the sheet is slit into proper widths ranging from 36 to 72 in., and wound into rolls weighing 1,000 to 2,000 lb. A number of different thicknesses of felt are made for the different classes and styles of prepared roofing. The finished rolls of felt are conveyed to the roofing mill by an overhead crane, where they are converted into finished roofing material.

In this New Orleans mill there are two roofing machines 250 ft. in length, one manufacturing a sheet up to 40 in. wide, and the other up to 72 in. The operation is continuous; at one end of each machine the rolls of felt are placed on an unwinding stand, and at the opposite end the finished roofing is wound into rolls or cut into shingles. As the rolls of base felt are unwound, the sheet is looped into continuous festoons on what is known as a looper or accumulator. This looper permits continuous operation of the machine during the splicing of a new roll of felt to the end of the roll unwound. From the first looper the sheet is drawn into the saturation tank. The progress of the sheet through this tank is over a series of steam-heated rolls at the top and a series of gates which dip down into the tank, containing hot saturating asphalt at a temperature of 430 deg. F.

The excess is squeezed off, and the sheet then passes to a second looper, where it is partially cooled.

In the next step the sheet passes to the coating machine, where hot coating asphalt is applied to both sides at a temperature of about 400 deg. F. Immediately after the asphalt-coating process is completed, surfacing materials are applied to the hot coating and thoroughly imbedded by passing over a series of water-cooled drums. While the sheet passes over these drums, which also assist in cooling it, a continuous weighing machine indicates and records the weight and is a constant check on the finished material. Saturating, coating, and surfacing operations are carefully controlled to maintain the correct weight and quality of the finished material.

From the cooling drums, the sheet passes into a final looper, where it is further cooled by air blasts. It is then drawn to cutters or winders, to be reduced to shingle form or wound into rolls. When roll roofers are made, sheets are wound on mandrels to the proper lengths, and the rolls are wrapped and placed on a conveyor where operators cover the ends for protection. Another conveyor carries the rolls to the warehouse or shipping department. If, however, shingles are made, the sheet runs through automatic cutters which cut to the proper size and design and drop the shingles onto traveling conveyors where operators inspect and stack them into bundles. A final conveyor takes the bundles to the packing room, where an automatic machine wires them for shipment.

Asphalt is received in tank cars provided with steam coils for melting, and is removed by means of steam-jacketed pumps and pipe lines to the steam-heated storage tanks or to the process.

Two grades of crude asphalt are blended and then oxidized or blown in a series of ten stills. Blowing refines asphalt and imparts to it the proper melting and penetrating properties. Stills are horizontal, ranging in capacity from 3,500 to 10,000 gal. each, and are equipped with tubes in the bottom through which a blower forces air during the refining process. Finished asphalts of different characteristics, depending upon the uses, are prepared in these stills ready for use on the roofing machines for saturating or coating the felt.

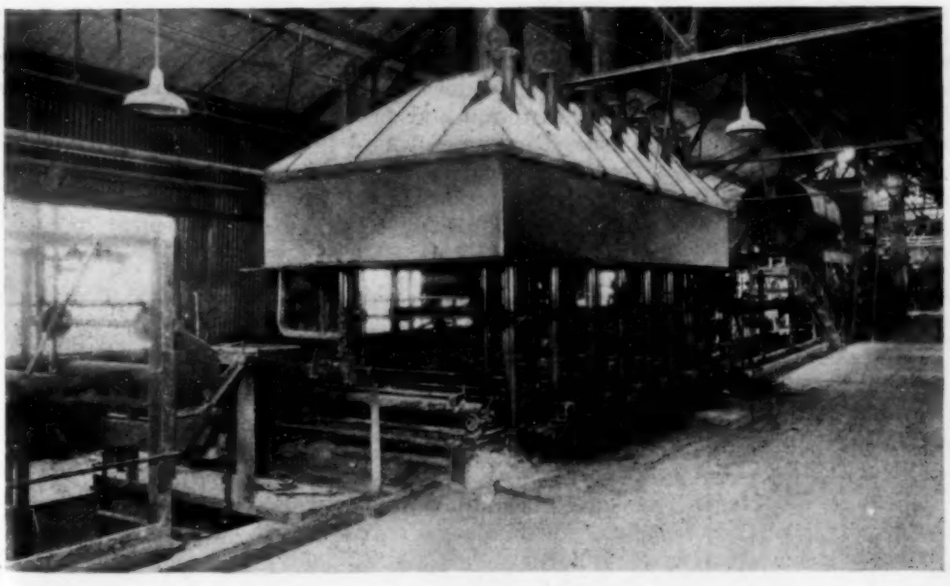
Each asphalt still is set in a brick furnace; heat is supplied through one low-pressure gas burner per still, this being located in the front brickwork close to the bottom. The gas and air are premixed at the burner and fired through a series of tile tunnels. The refractory material is brought up to incandescence, so that radiated heat as well as convected heat is furnished to the still.

In order to keep the asphalt hot in the saturating tank of the roofing machines, asphalt is circulated by pumping through superheaters or continuous heaters. These consist of banks of boiler tubes set in a brick furnace, equipped with gas burners at each end. A motor-driven pump keeps the asphalt circulating from the saturating tanks through the superheaters and back to the tanks, maintaining a constant temperature of 430 deg. F. in the saturating tanks. A magnetic shut-off valve is cut into the gas-supply line on the heaters, and this automatically cuts off the fuel supply to the burners in the event that current to the pump motor should fail.

For power purposes, this plant is provided with a modern boiler plant, consisting of two Edgemoor bent tubes and three drum-type boilers of 465 hp. each. Furnaces are set 8 ft. above the floor, leaving open space under the boilers, and are equipped with three gas burners each. Wind boxes are built into these. The furnace floors are constructed of firebrick, hollow tile, and insulation, and partially heated air is drawn from the hollow tile into the wind boxes for combustion.

Burners are cemented into the front walls, each consisting of two globular castings, one forming a jacket to the other, with sufficient space between for large volume flow of gas. Large openings with cast-iron necks are left on each side for the passage of air for combustion.

The plant is practically automatic. The desired steam pressure is maintained with a governor and diaphragm directly connected with a small pipe to the steam header, and with a shut-off valve in the gas-supply line on the other end. When the pressure builds up above the point set, the diaphragm is forced down, partially closing the gas valve and reducing fire under the boiler. There is a system of levers also connected with this device which acts at the same time to close dampers in the wind box and stack. Conversely, when the pressure has dropped again, the diaphragm rises, opening the gas valve and dampers and increasing the heat under the boilers.



Roofing Machine: Left to Right, a Portion of the Dry Felt Looper, Saturator, Saturated Felt Looper, Coater, Surfacing Machine, and Cooling Drums (Cutters and Winders Not Shown)

Metals That Resist Alkali Corrosion

By JOHN L. EVERHART
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PUBLISHED data concerning corrosion of metallic materials by alkaline liquors have dealt, in general, with corrosion by pure solutions. As a natural consequence, a number of metals represented as excellent in their resistance to caustic soda, for example, do not stand up well enough in plant liquors to justify that designation. This is due primarily to the fact that in rating the metals neither the small quantities of impurities present in plant liquors nor the effect of the combination of corrosion and erosion caused by flow of the liquors during processing have been considered.

In the manufacture of alkalis, mixed liquors are the rule and impurities are present in every stage of the process. These impurities range from the small quantity present in the calcium chloride liquor to the large quantity present in the electrolytic caustic soda liquor.

Table I—Typical Analyses of Liquors
(Gm./liter)

Liquor	NaOH	Na_2CO_3	$Na(H)CO_3$	NaCl	Na_2SO_4	$NaClO_3$	Na_2S
Caustic soda (lime)	690	2	...	1	18	..	Trace
Caustic soda (electro.)	580	8	...	170	3	4	Trace
Sodium carbonate	...	375	120	4	Trace	..	.....

Liquor	NH_4OH	$(NH_4)_2CO_3$	NH_4Cl	$(NH_4)_2SO_4$	$(NH_4)_2S$	NaC
Ammonium chloride	6	60	235	1	Trace	8
Sodium chlorides — ammonia	165	65	...	..	Trace	245

Liquor	$CaCl_2$	CaS	$CaSO_4$	NaCl	$MgCl_2$
Calcium chloride	1,500	10	Trace	3	Trace

Nominal analyses of a number of commercial metals and alloys which have been considered for service in these liquors are listed in an accompanying table, and a qualitative estimate of the value of these metals for service in liquors similar to those listed in Table I based on laboratory and service tests is given. In the table, "excellent" indicates that a long life may be expected; "good" indicates that the metal is suitable commercially; "fair" indicates that the material may be used but is not very durable; "poor" indicates unsuitability.

The rates of corrosion in the liquors vary greatly and it is necessary to consider them separately. Caustic soda liquor produced by the lime process contains small quantities of impurities. The analysis given in the table is that of a typical concentrated liquor. On the other hand, liquor produced by the electrolytic process contains considerable sodium chloride and smaller quantities of other sodium compounds. The losses sustained by metals in electrolytic caustic liquor are greater than the losses in similar lime-caustic liquor, due partly to the erosive action of the entrained salt which is carried along, mechanically, by these liquors after concentration. The difference is less marked with the hard metals and alloys than with the softer ones, as would be expected.

For resistance to solutions of this type, nickel and alloys containing a large proportion of nickel are outstanding. Monel metal should be used in the form of seamless material, as welds have had a tendency to crack. A 12 per cent chrome steel was little better than copper in its resistance to these liquors and considerations of cost led to its exclusion as a suitable material. Cast iron, because of its low cost, is still probably the best material for conditions to which it is adaptable.

The principal compounds in sodium carbonate liquor are sodium carbonate and bicarbonate, and corrosion is not a serious problem. Cast iron and cast steel are the best materials for use in liquors of this kind because of their low cost. It is interesting to note that aluminum, a metal generally considered unsuitable for alkali-plant use, showed good resistance to this liquor.

Ammonium chloride is one of a group of very corrosive liquors and few ordinary materials are suitable for use in them. The only alloy in the group under discussion which shows good resistance to this liquor is the nickel-chrome-molybdenum alloy. Unfortunately, it has limited applications because it is available only in the form of castings.

Sodium chloride-ammonium hydroxide is a typical mixed liquor containing sodium and ammonium compounds. Cast iron is particularly suitable for use because of its excellent resistance and low cost. The 18 per cent chrome-8 per cent nickel alloy is excellent for applications in which cast iron cannot be used. Although copper is listed as "poor" and the large ammonia content indicates that it is unsuited for this service, it resists this liquor very well in the absence of air, and therefore may have limited application.

Calcium chloride is a liquor which contains very small quantities of impurities, the principal one being sulphide. Monel cast iron shows excellent resistance to the liquor and most of the metals in the group are suitable for use with a liquor of this nature. This is another liquor in which aluminum showed good resistance to corrosion.

In general, cast iron with and without the addition of alloying elements, nickel, both ferrous and nonferrous alloys containing a high-nickel content, and cast low-carbon steel are the most important materials for use in these liquors.

Although there are various alloys which, when judged from the standpoint of resistance to corrosion, are better than cast iron and steel, cost considerations frequently make it more economical to use iron and steel even with more frequent replacements. In the final analysis, the most economical material will be determined by a consideration of probable service life, replacement cost, and obsolescence.

Table II—Metals Tested, Nominal Chemical Composition, and Corrosion Results

Material	Form	Nominal Composition (Per Cent) C	Si	Cr	Ni	Cu	Al	Mo	Fe	Corrosion Data: Caustic Soda (Lime)	Caustic Soda (Electro.)	Sodium Carbonate	Ammonium Chloride	Sodium Chloride-Ammonia	Calcium Chloride
Aluminum	Wrought	...	...	..	..	....	99	..	....	.....	.....	Good	.....	Poor	Good
Copper	Wrought	...	...	..	..	99.8	..	..	....	Fair	Fair	.....	Poor	Poor	Good
Nickel	Wrought	...	...	..	99	....	..	..	....	Excel.	Excel.	.....	Fair	.....	.....
Monel	Wrought	...	...	..	68	27	..	..	3	Excel.	Excel.	.....	.....	.....	Good
Cast iron	Cast	3.6	2.4	..	..	....	..	..	Bal.	Good	Good	Excel.	Fair	Excel.	Good
Monel iron	Cast	2.8	1.4	2	13	6	..	..	Bal.	.....	.....	Excel.	Fair	.....	Excel.
Steel	Wrought	0.2	...	..	..	....	..	..	Bal.	.....	.....	Good	Fair	Fair	Fair
12 per cent chrome steel	Wrought	0.1	0.5	12	..	....	..	..	Bal.	Fair	Fair	.....	Fair	Fair	Good
18-8 steel	Wrought	0.1	0.5	18	8	....	..	..	Bal.	Good	Good	Excel.	.....	Excel.	.....
Nickel-chrome-molybdenum	Cast	...	...	25	35	....	..	5	Bal.	Excel.	Excel.	.....	Good	.....	Excel.

How Your Power Costs May Be Reduced

By B. R. CONNELL

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A LARGE number of the electrochemical and electrometallurgical processes require direct current, and in a majority of plants this is obtained by conversion from an a.c. supply. This supply usually is purchased from an outside source, although in a few cases it is generated at the plant.

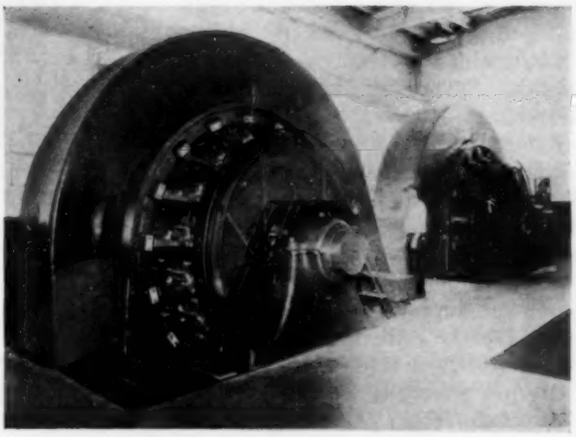
In many of these processes the cost of power may be an important item in the total cost of the finished product. It is, therefore, important, especially under present conditions, that the conversion equipment selected be reliable and meet requirements most efficiently and economically. A review of the characteristics of equipment available may, therefore, be of interest.

Types of Conversion Equipment

At present there are three types of conversion equipment that may be considered for this service, within their proper voltage ranges. They are: (1) synchronous converters, (2) synchronous motor-generator sets, and (3) mercury-arc rectifiers. Induction motor-generator sets are not included, as they are not economical in the sizes under consideration, and rectifiers of other types are as yet available only in smaller ratings.

The type of conversion equipment selected for a particular installation should be decided upon only after consideration of all special requirements imposed on the electrical apparatus by the particular process in question and a study of how the characteristics of the apparatus available will meet these requirements. While it is recognized that process requirements as a whole may overbalance certain considerations of the electrical equipment itself, it is believed that in some cases an understanding of the effect of these requirements on the electrical equipment might limit special requirements, sometimes imposed, and thereby show an advantage in cost and efficiency of the whole plant. One example is the amount of d.c. voltage variation specified under load, as with either synchronous converters or mercury-arc rectifiers this has a considerable effect on the price and some effect on the over-all efficiency of the equipment.

In many metallurgical processes the kilowatt rating of conversion apparatus is a unit with the cell or load line and is, therefore, fixed accordingly. However, where this rating is not so determined, the conversion unit should be made as large as is consistent with the ultimate plant rating contemplated, taking into account the spare capacity that may be desired to insure continuity of service. In general, the larger the rating, up to economical limits of construction, the lower the cost, floor space, and weights per kilowatt, and the higher the efficiency.



Synchronous Converters With Volute Ventilating Housings in Electrolytic Service

The particular type of plant or process under consideration determines to a great extent the d.c. voltage required. Based on the present practice, electrolytic refining, for instance, requires d.c. voltages of 150 and below; many electrochemical processes require a voltage of 250 to 300, and the electrolytic extraction or reduction of metals, such as copper, zinc and aluminum, requires voltages in the range of 500 to 650.

It should be recognized, however, that, in general, the higher the d.c. voltage selected for the converting equipment, the lower the price per kilowatt, and the higher the efficiency. Therefore, voltage should be made as high as process requirements will allow. It is quite possible that present practice as regards voltage standards in some electrochemical processes could be increased without difficulty to process or hazard to operators, and thereby increase the over-all plant efficiency.

Equipment Which May Be Considered

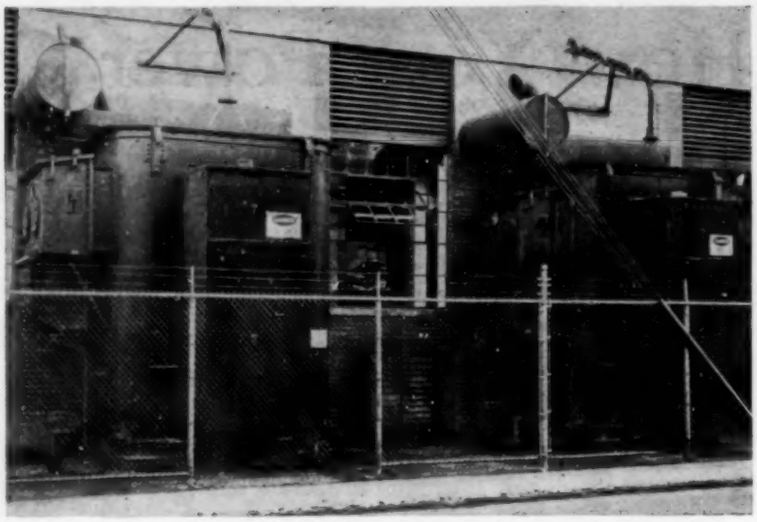
The d.c. voltage selected determines to a great extent the type of conversion equipment which may be advantageously considered. This is indicated as follows:

(1) 125-volt class—motor-generator set; (2) 250-volt class—motor-generator set or synchronous converter (the rectifier has as yet had little application in this field); and (3) 600-volt class—motor-generator set, synchronous converter, or rectifier.

Electrolytic work usually is 24-hour service with a high load factor; and, therefore, it is now the general recognized practice to rate equipment on a continuous basis with a conservative temperature rise and revolving apparatus with a conservative speed. These factors tend to increase the life and lower maintenance of equipment and make for greater continuity of service. In the comparison following it is assumed that these items have been given equal consideration for all three types of

apparatus and that they are designed for comparable heating, commutating characteristics and speeds.

After selection of the d.c. voltage and the kilowatt rating of the equipment, the following are some of the factors which should be taken into account in a comparison of different types of apparatus, although not necessarily in their order of importance: efficiency, cost of apparatus and installation, reliability, methods of obtaining voltage variation, power factor, maintenance, floor space and weights. Several of these items are interrelated—such as d.c. voltage variation required and power factor specified, since these will have an effect on the initial price and the efficiency of equipment and, in some cases, on floor space and weights.



Transformers Equipped With Load-Ratio Control and Y-Delta Starting Switches in Electrolytic Service

Certain other factors, such as voltage of the supply system, may have an effect on the equipment, but usually this is already determined by the location of the plant and is not generally subject to selection. With a synchronous converter or mercury-arc rectifier, transformers are required for any supply voltage, but motor-generator sets, particularly in the larger sizes, may be economically wound direct for supply voltages up to and including 13,200. For supply voltage much above this, it is usually advisable to install transformers. The addition of transformers, therefore, will increase the price, floor space, and weight, and lower the over-all efficiency of the motor-generator-set equipment. In the following comparison it is assumed that transformers will not be required for motor-generator sets.

Efficiency of Different Types

The relative efficiency of different types of equipment depends somewhat on the kilowatt rating, the power factor and amount of d.c. voltage variation required and to a considerable extent on the d.c. voltage selected.

The effect of this latter item is illustrated by the mercury-arc rectifier, in which the main loss is in the arc drop. This is, practically speaking, independent of the d.c. voltage rating, resulting in comparatively low efficiencies at d.c. voltages such as 125 or 250, but higher efficiencies at voltages of 500 to 650. The efficiency of a mercury-arc rectifier is higher also at fractional loads than at full load. This characteristic is important in applications having a low load factor, but not so important in electrolytic service with its high load factor.

Developmental work is being carried on rapidly toward increasing efficiencies of rectifiers, particularly in smaller sizes and lower voltages, so that this situation may be changed at a later date.

The following comparisons refer to general average conditions:

In the 125-volt class, a converter will have a higher efficiency than a motor-generator set. In the 250-volt class, the synchronous converter will have an efficiency at full load 2 to 4 per cent higher than a motor-generator set. A rectifier will have an efficiency slightly below a motor-generator set around full load and higher at light loads.

In the 500- to 650-volt class, the mercury-arc rectifier shows to better advantage from the efficiency standpoint, as it is essentially the same as a synchronous converter at full load and usually higher at light loads. Both converter and rectifier, including their transformer losses, will be from 1 to 3 per cent higher in efficiency, at full load, than a motor-generator set.

Comparative Costs

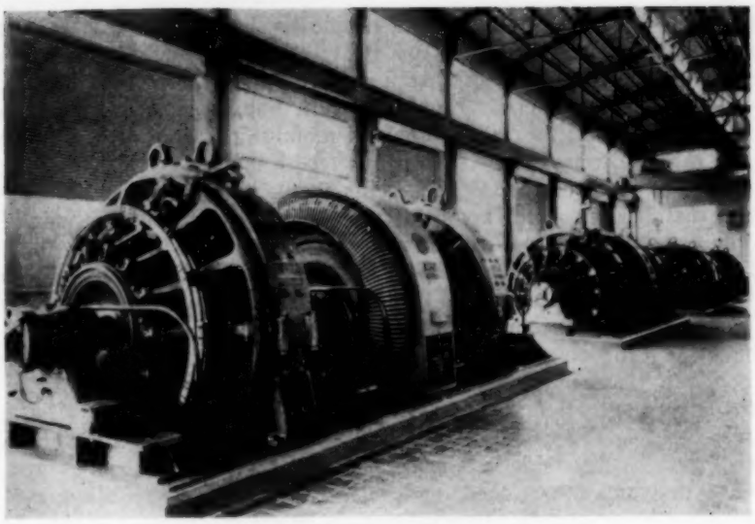
The comparative costs of the different types of conversion equipment are affected by a large number of factors, such as the kilowatt rating and speed; the a.c. voltage, frequency, and power factor; the d.c. voltage and voltage variation required. It is impossible, therefore, to make any general comparison that will hold for specific conditions. The following comparison is based on an average of a.c. voltages and frequencies without special requirements for any type of equipment and may vary considerably for a particular installation.

In the 125-volt class, the cost of the converter equipment will usually be much higher than that of a motor-generator set. And in the 250-volt class and sizes from 500 to 3,000 kw., the cost will be in favor of the converter in the smaller sizes and in favor of the motor-generator set in larger sizes. The cost of a rectifier in this voltage class will generally be higher than that of either of the other types of equipment. In the 600-volt class and sizes from 500 to 5,000 kw., the cost is in favor of converter over both motor-generator set and rectifier and in favor of motor-generator over the rectifier. The differential decreases as the kilowatt ratings increase.

Costs of Installation

In comparing the installed cost of equipment, including apparatus, foundations, building and installation, labor and materials, the three types of equipment usually will be found to be more nearly equal for average conditions.

Modern synchronous converter and motor-generator set are both considered reliable when properly applied. Where the conversion plant is operated on a transmission system which is subject to voltage variations or short-circuit disturbances, a motor-generator set will be more reliable. Such disturbances affect a converter more seriously than a motor-generator set, due to the fact that in a converter the a.c. and d.c. sides are connected elec-



Four Motor-Generator Sets in Electrolytic Service in the Plant of the Anaconda Copper Co., Anaconda, Mont.

trically so that any variation in a.c. voltage appears in d.c. voltage and, if of sufficient magnitude, will cause commutation trouble. In a motor-generator set the connection is mechanical with no direct electrical tie between the a.c. and d.c. sides. System frequency changes, however, are reflected in the d.c. voltage of a motor-generator set due to speed changes of the driving motor.

Several rectifiers have recently been installed in Canada for electrolytic service and have been used to some extent for this service in Europe. The design of rectifier equipment has been improved to such a point that it is now considered a reliable type of apparatus for railway service and should be at least equally reliable in electrolytic service, as it does not impose as severe and sudden overloads.

Voltage Variation Under Load

As previously mentioned, the d.c. voltage variation specified for a particular installation has an effect on the price of equipment and also its efficiency, varying for different types of equipment. In general, the smaller d.c. variation required, the lower the price and higher the efficiency of equipment. Therefore, it is important that this range be made only as wide as is actually necessary to suit the process requirements.

With a motor-generator set, d.c. voltage variation is obtained simply and at comparatively small expense by shunt-field control of the generator. In general, a variation of approximately 20 per cent below normal can be obtained with a self-excited generator. If a wider variation is required, generators should be separately excited. This excitation usually can be supplied from whatever source the synchronous motor obtains its excitation, either from an exciter on the set, or from a separate source. In a few installations two direct-connected exciters are furnished, one for exciting the generators and one for the motor.

With synchronous converters and rectifiers, a d.c. voltage variation beyond a few per cent cannot be obtained as readily as with a motor-generator set, and additional equipment is required. Among the several methods of obtaining d.c. voltage variation, the following are the most commonly used. All three methods apply to converters and the last two to rectifiers: booster—direct-connected or separately driven; load-ratio control on transformers, and induction voltage regulator.

In small and medium-size converter equipments, the most economical and efficient way of obtaining voltage regulation usually is by a self-contained booster which is built as part of the converter. The usual limits are 15 per cent plus and minus from the mid position for this type of equipment. For the large-size converters, a separate motor-driven booster set operating at considerably higher speed than the converter is preferable from the standpoint of price, operating characteristics, and ventilation of the converter.

A small voltage variation may be obtained on a converter by field control, but this is not usually recommended, as it affects adversely the commutation, heating and power factor of the converter equipment. This method, however, is used in small percentages with specially designed converters in conjunction with load-ratio control equipment on the transformers to obtain a closer variation between the transformer-tap points.

With a rectifier, voltages desired between the transformer-tap points may be obtained by the use of grid control in the rectifier. Moderate ranges in rectifier voltage may be obtained also by grid control alone.

Load-Ratio Control Equipment

Load-ratio control equipment is now being used for obtaining wider d.c. voltage variation on both converters and rectifiers, especially where high efficiency is desired. By this means the a.c. voltage to the converter or rectifier is varied by the use of taps in the transformer winding. These may be arranged to provide for the d.c. voltage variation required and also to compensate for variations in the a.c. supply voltage. A sufficient number of steps can often be obtained to give reasonably close voltage steps on the d.c. side of the converter, and any additional voltages required between these points can be obtained by field control on the converter or grid control on the rectifier.

This load-ratio control equipment has proved itself reliable and is simple to operate. It may be manual or motor-operated and governed by a control on the switchboard panel similar to that used for motor-operated rheostats or governor control. As the secondary side of the transformers is of the multi-phase type with heavy current windings, it is the practice to place the load-ratio control equipment on the primary windings of the transformers, which, for the usual supply voltages, introduces no difficulty.

Variation by Induction-Voltage Regulator

Another method of voltage variation is by the induction-voltage regulator used to some extent in European practice but not used to a great extent in this country. The induction regulator method usually means somewhat lower efficiency and lower power factor for the equipment and in most cases increased price. It would not be recommended except for small equipments or where other types of voltage variation could not be used.

The question as to whether or not power-factor cor-

rection is necessary or desirable at the particular plant also has some influence on the equipment selected. By the use of a synchronous motor-generator set the motor may be designed for a leading power factor to obtain any reasonable power-factor correction desired, usually with only a comparatively small effect on cost up to ratings of 0.8 p.f. leading. A synchronous converter should be operated at approximately unity power factor, so that power-factor corrective capacity is not readily obtained with this type of equipment.

Power Factor

Power factor of the mercury-arc rectifier equipment is not controllable in the rectifier itself but is dependent somewhat on the rating of the equipment and particularly on the transformer connections used. It is usually between 93 and 96 per cent lagging. To correct this to near unity power factor, some expense is involved; this type of equipment, therefore, is not suitable for power-factor correction.

It is often found in an electrolytic plant, however, that the conversion equipment is such a large part of the total plant load that even though it is not designed for power-factor correction, it of itself, being of a high power factor, gives a fairly high plant power factor, often above the usual limitations where power-factor penalties are imposed.

As converters and motor-generator sets have been in service for a number of years, fairly reliable data are available on this item, and it is generally accepted that maintenance of a converter will be higher than that for a motor-generator set. This is due to the fact that a converter has both a.c. and d.c. brushes to replace, whereas on a motor-generator set only d.c. brushes need periodic renewal; the upkeep of the brushes on the motor-collector rings is a small item.

At the present time meager data are available regarding the maintenance on mercury-arc rectifiers in electrolytic service; judging from the records of modern rectifiers in railway service, this item should be smaller than for either of the other types of equipment, since the rectifier is not of the rotating type and there are no parts that require periodic renewal.

Floor Space and Weight

The floor space and weight of conversion apparatus determine the size of the building and the foundations required and, therefore, have an appreciable effect on the installed cost of the apparatus and complete electrical station. Considering the conversion apparatus alone, without transformers, both the floor space required and weight will be highest for motor-generator sets, with synchronous converters next and mercury-arc rectifiers the lowest. Where transformers are required for all three classes of apparatus, the same comparison will hold.

Comparing converters and rectifiers with their transformers and motor-generator sets without transformers, the total floor space and weight will be greater for a converter than for a motor-generator set. The mercury-arc rectifier equipment will be smaller and lighter than either of the other types. In many installations, the main transformers may be installed out of doors, thereby reducing the size of the building required.

The mercury-arc rectifier offers a considerable advantage over rotating types of equipment from the standpoint of foundations and ease of installation. The rectifier and its immediate accessories are mounted on a common base and, due to the absence of rotating parts, the erection is limited to the simple leveling of the unit. It is not necessary to use heavy concrete foundations, as a floor capable of sustaining the weight of the rectifier unit is sufficient. Lighter weight equipment also allows a saving in crane costs and mounting. These items mean a considerable saving in over-all station costs.

There are others items that should be taken into account in the layout of a plant. The different methods of starting the equipments in a large installation will affect the flexibility of operation, the building arrangement and cost of same, and they should be carefully considered for each specific installation. And the layout of the switching control equipment for a large plant should be given careful consideration in order to obtain flexibility of operation without excessive cost.

The usual electrolytic station, with its high load factor, has considerable heat liberated from the converting apparatus, switches, and buses. Therefore, ventilation of the station, especially if in a warm climate, should be given consideration so as to provide sufficient cool, clean air for the apparatus and a reasonable temperature for the operators.

Ventilation of the Station

In the past few years a careful study has been made of the air circuits around converters and motor-generator sets and a system designed to collect definitely the heated air as discharged from the machine. This consists of involute housings around the machines arranged so as to collect the hot air and discharge it out of doors or in such a way as not to mix with the incoming or station air. Arrangements can be made to discharge into the operating room sufficient warm air for heating in periods of cold weather. By the use of this arrangement, machines are supplied with air at the lowest ambient temperature available and the machine room also is maintained at a temperature suitable for the operators both summer and winter. As the air is definitely directed, less has to be handled, which results in a lower first cost of ventilating equipment and also considerably lower operating cost.

Mercury-arc rectifiers, being water-cooled, do not require special ventilation but should be located so that any heat thrown off will not be pocketed. The transformers, if self-cooled, should also be placed so as to receive the air necessary for their cooling.

Dust Should Be Avoided

If the station is located where the air carries dust or dirt, it is, of course, advisable either to clean the air by dry filters or air washers, or to inclose the machines completely. In some cases clean air may be obtained from another location and brought to the inclosures by ducts. If this cannot be done, the housings should be equipped with coolers so that the ventilating air may be cooled and recirculated in the inclosure. Where the machine room is comparatively small, the whole room may be considered as a housing if desired, and its air recirculated and cooled.

If there is any appreciable amount of acid, chlorine or other injurious fumes in the air used for ventilation, it will seriously affect commutation of converters or motor-generator sets and possibly the operation of the circuit breakers. For such a condition it is necessary to give particular attention to obtaining air free from fumes and it is recommended that the equipment be inclosed, as described in previous paragraphs on dirt conditions.

Chemical Engineering Develops New Fertilizer Process

By B. G. KLUGH

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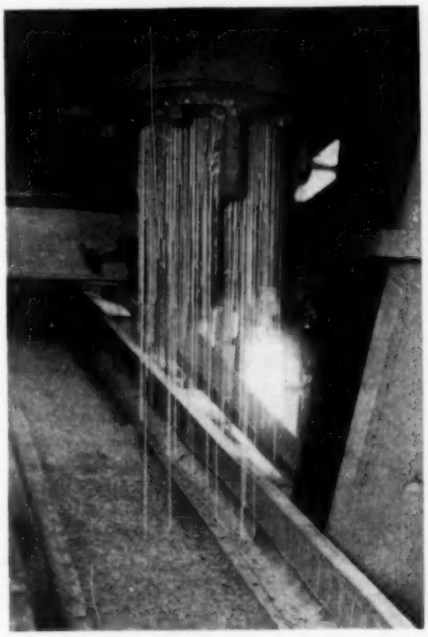
ONLY in proportion as it serves the economics of agriculture can the chemical fertilizer industry prosper. Its existence depends upon its contribution to profitable farming. Fertilization is justified only to the extent that it increases value in yields and quality greater than the total cost of its application. Fertilizer research is justified only wherein its objective is directed toward improving agricultural conditions.

Ideal economical fertilization consists in supplying each plant with exactly its needed quantity and precise ratio of specifically available plant nutrients, in correct relative placement and at proper time, responsive to its requirements for optimum growth and fruition. Accuracy and uniformity of quantity application require uniformity of particle size. To provide this accuracy and uniformity for varying requirements of ratios for different soils and crops, this uniformity of size must prevail equally effective for all ratios demanded.

The foregoing general specification of fertilizer characteristics relates to physical forms. The chemical combinations of plant nutrients for their most effective utilization in the various plant, soil, and seasonal influences are equally important considerations in the fertilization economics of the future. This automatically develops the premise that *advancement in production of fertilizing chemicals demands a process whereby any combination of the range of desirable and available plant nutrient compounds shall be incorporated into physical forms embodying non-segregable stability, uniformity in shape, size and analysis, and resistance to hygroscopic influences for all normal storage and handling conditions. Naturally, the processing and over-all conversion costs of such a process must be lower per unit of plant food than those of present processes to justify its economic adoption in industry.*

In the present state of applied chemistry, in its relation to fertilizer materials, only the compounds of nitrogen, phosphorus, and potassium are involved. The essential elements of calcium and magnesium are deferred from this immediate description for discussion separately in the economic considerations. The available chemical compounds of the three fundamental plant food elements include ammonium nitrate, urea, mono-, di-, and intermediate ammonium phosphates, potassium chloride, sulphate, nitrate and phosphates. From this group of compounds any ratio of the three fundamental elements may be made up in stable and soluble form. All the above compounds are produced usually in crystalline form. In this research project the early erroneous assumption was held that producing and selecting crystals of uniform size of all the required compounds for any desired ratio, and mixing them, would fulfill the requirements for the fertilizer ideals above enumerated. On this false basis considerable quantities of highly concentrated fertilizers were made up of the mixed crystalline salts and packed and sold. While they left the pilot plant in apparent free flowing uniformity, they all later reappeared in uniformly hard blocks in perfect conformation to the contour of their containers.



Extruding New Drillable Concentrated Fertilizer

These spaghetti-like strings are dried and then cut into pieces an eighth inch long to give the finished product shown on page 95.

This established that some entirely different line of attack was necessary to solve the problems at hand. The widely developed arts of spray drying and spray congealing into globular forms were considered. However, the fact that the melting or drying temperatures required are above the decomposition points of a number of the desired salts disqualified these processes for general adoption. A number of other efforts were made along lines of the multitudinous modifications of nondescript and applied stirring, rolling and otherwise manipulating of progressive stages of liquid to solid masses that come within the omnifarious terminology of "granulation." In no case did any results provide particles of sufficient uniformity in shape, size, or contour even to approach the degree of "drillability" essential to meet the farmer's requirements for its accurate application.

It was then decided to direct the objective toward a process of controlled formation of each individual particle, from a positively homogeneous mass of constituent salts. Spherical particles of homeopathic pill proportions appeared to be the ideal form. However, study and investigation determined that such a product required intricate pharmaceutical equipment involving maintenance and attendance costs beyond any bearable fertilizer production costs.

A general conception evolved the principle of extruding a homogeneous paste through apertures of the desired diameter and subsequent or currently cutting the extrudes into desired lengths. A most nearly universally applicable size of 2 mm. diameter and 1½ diameters, or 3 mm., long was set up as a standard. Some pastes of salts with their aqueous solution of consistencies thought to be extrudable were laboriously fabricated by hand when all available types of mixers selected failed. Samples of these pastes were sent to specialists in extrusion machinery and operations, with request for advice and counsel as to the proper equipment and operating data required for their extrusion. The outside consideration and study of this problem involved considerable delay, and finally brought the report that these pastes were not truly plastic and hence were not subject to extrusion. However, the research workers on this immediate problem in the Swann Chemical Co. laboratories were in the meantime continuing their efforts at extrusion of these salt pastes, in blissful ignorance of their unextrudable properties; in fact they had already extruded some when the negative and belated expert advice reached them. With the benighted evolution of a few ounces of product

Slightly condensed by the editor of *Chem. & Met.* from an original paper presented before the New York Chapter of the American Institute of Chemists, Feb. 5, 1932.

establishing the possibility of extruding a non-plastic, two combined and interdependent problems arose for solution: One, the economic preparation of the salt pastes of extrudable consistency, the other, the determination of the conditions under which the extrusion is performed, and the development of equipment controlling these limiting conditions.

New Type of Mill Developed

In the paste production, all of the types of mixers involving the principle of interacting blades or knives failed. The salt paste, when approaching the extrudable degree of plasticity, develops such a tenacious toughness that no cutting mechanism will continue to cut through it by any reasonable application of power upon it. The edge runner type of mill in which scrapers are coordinated with roller mullers has been most successful in carrying out this required combination of operations. The control of the effective weight of these rollers is a determining factor in the success of the operation.

The functions to be performed in this mill consist of grinding the salts to a finely divided state, providing surface contact of the entire mass for intimate and progressive gas reactions, intimate admixture of the entire mass throughout the cycle, and final kneading of the mass to homogeneous extrudable consistency. The effective weight of the mullers is of greater requirement in the grinding operation and is essentially limited in the kneading operation. Heavy rollers passing over the paste compress it to a point of forming hard cakes, thus destroying the required homogeneity for extrusion. This feature was corrected by developing a mill in which the muller rollers are mounted in individual independent suspension with selective counterweighting, whereby a change from heavy effective weights in the grinding stage is instantly effected to light weight for the kneading stage. Under this kneading action the alternate pressure and release cause alternate solution and reprecipitation of the salts with their associated solution, so that there is effected a final equilibrium between the infinitely fine particles of the combination of the salts and the solution with which they are bound together.

In the preparation of this paste the combination of the bases, acids, and neutral components is effected simultaneously with the grinding, mixing, and kneading operation. This effects substantial economy in the conversion cost of the ultimate product from the basic materials. For nitrogen and phosphorus compounds the cheapest raw materials at present available are ammonia and phosphoric acid. Both require fixation for use in fertilizers. The production of ammonium phosphate, either the mono-, di- or intermediate stages, involves comparatively expensive equipment of solution, neutralization, evaporation, crystallization and handling of relatively large quantities of mother liquors. In this described procedure all such operations are bypassed.

The processing mill has the pan, scrapers, and muller mechanisms inclosed in a pressure-tight hood. The potash and other salts available as such are passed into the pan through valve-locked means, and the liquid phosphoric acid and gaseous ammonia passed into the pan in controlled proportions. The combination of the ammonia and phosphoric acid is effected simultaneously and coordinately with the grinding of the salts. The ammonium phosphate is thus precipitated in finely divided state on the progressively developed surfaces of the grinding salts. The combination is thus effected completely without solutions or any processing residues for re-treatment. The complete combination of the NH_3 and H_3PO_4 is effected up to diammonium phosphate in ten minutes where pressure is applied. Dispersion of the heat of reaction and its use for evaporation of accompanying water is automatically effected through adjuncts developed in the design of this processing mill.

This provides means for producing uniform combinations of any intermediate molecular ratio of salts. Crystallization can produce only salts having definite molecular ratios. For instance, NH_3 and H_3PO_4 will crystallize only as $(NH_4)H_2PO_4$ and as $(NH_4)_2HPO_4$. Where an intermediate proportion of N and P_2O_5 is desired, a mixture of crystals would be available only where the old crystallization method is used. It was shown above that a permanent uniform mixture of the crystals of mono- and of di-ammonium phosphate is unattainable. In this process any ratio of the salts above mono-ammonium phosphate may be produced with absolute assurance of permanent homogeneity and stability. The same thing applies to any other salts and compounds that may be desired, as, for example, anhydrous ammonia solutions of ammonium nitrate.

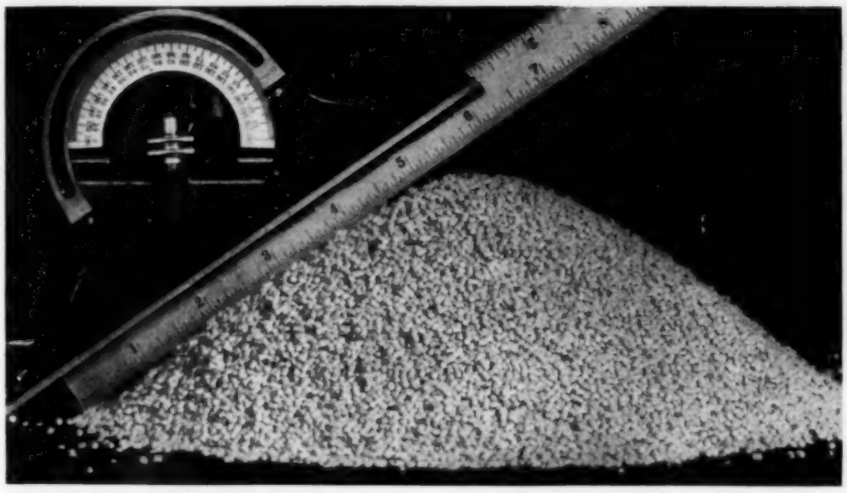
The operation of this stage of this process is essentially intermittent. It was therefore essential that means be developed for eliminating all possible labor and delays in loading, processing, and unloading. The design of mill, which is confidently worked out from data obtained from several pilot mills up to 500-lb. batch sizes, is for one-ton batches. The mill will run continuously and the salts, acid, and ammonia are charged into it simply with valves. The regulation of the selective counterweighting for the two steps of grinding and kneading is effected by one valve. The unloading of the sticky, gummy paste from this mill appeared to be quite a problem at first, but there has been developed a vertical screw which moves down, automatically removes the complete charge in maintaining sealed relation with hood, and moves back in three minutes. Only one attendant is needed for two mills, each completing a cycle of operation every 40 minutes. The paste is delivered by means of this unloading screw directly into the hopper, from which the extrusion machine takes its feed automatically.

Extruding and Screening Operations

The extruding mechanism has required complete development in all details. Standard extrusion machines built to operate upon plastic materials are utterly useless on this character of materials. Six different machines have been built and from these all the fundamental principles and data for larger unit design have been developed. The pilot machine at present in operation has a capacity from 1,000 to 1,500 lb. per hour and is in daily use on production for field tests. The paste is fed by hand and the extruded material in long sections drops on a cooling and hardening conveyor. This treatment consists in blowing cold air through the screen conveyor carrying the freshly extruded sections, which hardens them sufficiently to withstand temporary storage, and to the drying and handling operation immediately following.

The extrudes upon discharging contain about 6 per cent water. The cooling and hardening conveyor reduces this to about 4 per cent. The drying operation consists primarily in circulating the sections through a cylindrical dryer. With product containing diammonium phosphate, the temperature of the extruded sections must be maintained below 70 deg. C., which requires about 8 hours to dry them down to about 0.75 per cent water. This drying time is not a serious burden, since no labor is required except the charging and discharging. It is proposed that a compartment cylindrical dryer be used, having a capacity of ten tons; hence, one dryer would be required for each 30 tons daily, or 10,000 tons annual capacity. The dried product consists of sections $\frac{3}{4}$ in. diameter in lengths from $\frac{1}{4}$ in. to $\frac{3}{4}$ in.

The next step consists in cutting and screening the sections to uniform lengths of about $1\frac{1}{2}$ diameters, or $\frac{1}{8}$ in. The screening involves complete separation of all the undersize product or fines, and the separation of the desired length ($\frac{1}{8}$ in.) from the longer lengths of the same diameter. Obviously such a screening requirement demands rigid characteristics. A special screen required development. This is a wire screen having a low amplitude of vibration that will cause the product to flow over its surface with all particles substantially in contact with the screen. Any of the longer particles projected by the vibration for a distance more than that of their diameters will likely pass through the screen openings endwise.



This New Drillable Fertilizer, in the Form of Cylindrical Granules Resembling Smokeless Powder, May Be Made to Contain Any Desired Ratio of Plant Foods, as Shown in Table to Right

A screen has been successfully developed which very satisfactorily makes a complete separation of the product in one pass over the multiple set. The overlengths pass off the screen into a cutting roll, which cuts them into exactly the desired lengths and returns them in circuit with the screen described. This cutting roll is the result of considerable research and experimentation. It consists of two parallel rolls, the lower roll having longitudinal grooves just fitting the extruded sections. The upper roll has transverse grooves of duplicate contour to those on the lower roll. The upper roll revolves in counter-clockwise direction, opposite to that of the lower roll and with ten times the peripheral speed. The result of this coordinated arrangement and motion is that the sections can be carried into the cutting zone only between the rolls when they are lying in the grooves of the lower roll. The grooves on the upper roll form circular knives at their intersections, which serve to cut the sections into exact lengths.

The product is now ready for bagging and shipment. The fines is less than 3 per cent of the total product and is returned to the processing mill for re-treatment. This product consists of hard, dense, smooth-surfaced, particles of uniform size and shape. The drying operation produces a surface having even greater density than the interior. This is due to the fact that the water content, forming a saturated solution, must migrate to the surface as a solution. It is there that the water is evaporated, leaving the residual salts therefrom filling the microscopic interstices at the surface of each particle. The rolling and polishing action removes all minute projections from the surface. This is an important factor in the hygroscopic resistance of the product, since a perfectly smooth surface presents vastly less relative area for retention of atmospheric moisture, with its caking effect, than a surface with even minute projections and undulations.

It appears safe to state that this form of product has at least twenty times the hygroscopic resistance of the corresponding mixture of crystalline salts. That is, where open piles of this product and corresponding crystalline salt mixtures are exposed to the same atmospheric condition the crystalline salts were caked hard in six days, whereas the extruded product described remained loose and showed only slight caking after 120 days. Shipment has been made in paper-lined bags, and in no case has there been any report other than that the product remained loose and free-flowing after several months.

The first production of this product began in January, 1930. Several lots have been retained in storage tests which passed through the entire spring, summer and autumn in an unheated, well-aired building in Anniston, Ala., with no caking whatever. During the season of 1931 about 75,000 lb. of this drillable concentrated fertilizer was produced. It was all used in field tests. Although its physical and chemical characteristics met substantially all the requirements set forth in the ideal specifications developed, it is, of course, necessary to prove its value in actual field tests. A large portion of this product was donated and the field tests were conducted under direction of county agents. Twenty different states received some of this product. Over 700 field tests were made in the initial year 1931. The conclusive facts reported, and confirmed by cooperating planters, from this series of tests are all highly favorable to the new product.

While upward of 100 different ratios of N, P_2O_5 and K_2O from substantially all available fertilizing chemical compounds have been produced in the pilot plant, only a limited number were used in field tests. It was desired to make comparative tests of all the ratios possible within themselves, and the number of tests available limited the possible number of ratios subject to comparison. The ratios used in field tests consisted of:

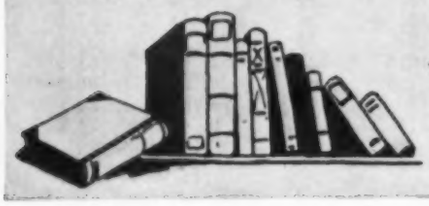
N	P_2O_5	K_2O	Total Plant Food
17	34	17	68.0
13	34	20	67.0
13	26	26	65.0
10.5	21	32	63.5
7.5	39	20.5	66.5
14	42	14.0	70.0
21	53	0	74.0

Questions have arisen as to the omission of needed plant nutrient elements of calcium, magnesium, manganese, and of minor elements. The elements may easily be incorporated in the new form of drillable concentrated fertilizer and, wherever demanded specifically, they will be so supplied. However, their omission in this stage of this research development is based upon economic consideration of the farmer's interest. There is no question whatever as to the absolute needs of calcium and magnesium for many specific soils and crops. However, soil amendment correction demands lime in quantity many times that of the principal nutrients of N, P_2O_5 and K_2O. Therefore, if the full lime requirement for any specific acid soil were incorporated in the fertilizer, the grade would be actually lower than the present minimum legal requirements. The lime requirement likewise varies with soils and crops. No standard ratio of CaO to N, P_2O_5, K_2O is possible. Hence, any given CaO content of the complete fertilizer is likely to be deficient for the needs or to be an unnecessary component.

Where the farmer needs lime, he can obtain it at lower delivered cost directly from the source rather than through the fertilizer. If the lime is incorporated into the fertilizer, the consumer is essentially burdened with the costs of the freight from the lime quarry to the fertilizer plant, plus a profit on its purchase cost by the fertilizer manufacturer, plus the cost of handling and processing cost into the fertilizer, plus the cost of bagging in proportion to its relative weight, plus the cost of freight to his point of delivery. These additional costs can be eliminated in the farmer's important production cost by purchasing his lime and applying it separately where and as needed.

The pilot operations and field tests of 1931 established the achievement of the principal objective sought. The pilot-plant production and field test work will be continued in 1932 more intensively and extensively than the previous work. Before-embarking upon a large production program it appears expedient and desirable to continue this work upon a research basis for at least another year in an effort to prove all points of production and application, and to determine features of improvement whereby agriculture may be better served through this development.

CHEMICAL ENGINEER'S BOOKSHELF



Essentials of Economics

ECONOMICS FOR ENGINEERS. *By Edison L. Bowers and R. Henry Rowntree.* McGraw-Hill Book Co., New York City, 1931. 478 pages. Price, $4.

Reviewed by THEODORE M. SWITZ

IT has become a truism among those engaged in finance or business management that the majority of even very capable engineers are notoriously ignorant on the subject of economics. Yet to solve the complex problems of modern industry, both engineering and economic knowledge are required. "Economics for Engineers," if read with some care by engineering students or operating engineers, will probably achieve more than any other recent book in making intelligible to our profession the language and problems of the economist.

The book has none of the "dry-as-dust" flavor of most works on economics, but instead is packed with detailed practical examples, with interesting charts and tables, and has in addition an excellent set of references at the end of each chapter to most of the worthwhile books on economics and scientific management that have appeared in recent years. The subject is obviously immense and, from the point of view of the professional economist, the authors have somewhat weakened their presentation by commenting, at least superficially, upon most of the major problems of modern economics and sociology. Despite this criticism, however, the book is a valuable contribution to a little-known subject and deserves a place on the bookshelf of those engineers who wish to become acquainted with this important field.

America's First Scientist

THE INGENIOUS DR. FRANKLIN. Selected Scientific Letters. Edited by *Nathan G. Goodman.* University of Pennsylvania Press, Philadelphia, Pa., 1931. 244 pages. Price, $3.

IT WOULD be hard to choose more appropriate or stimulating spare-time reading for a profession that lives by its scientific wits than this selection from the versatile mind of Benjamin Franklin. Historical perspective emphasizes his increasing stature among the greatest products of the American soil: an independent character, fertile, unique, yet unmistakable in origin, and welcomed, without apology for it, everywhere. That his many-sided interests constantly enrich each other becomes apparent in his highly diversified scientific utterances, which, in addition, give his native curiosity and resourcefulness especially free play.

Among the communications so attractively collected in this volume are the reports on the hydrogen-gas balloon of Paris, the buffoonery on daylight saving (by retiring and arising betimes), the explanation of his efficient, improved fireplace; the experiments on cooling by evaporation; and the account, to Priestley, of the flammability of marsh gas. Whatever his subject, it finds fertile soil in Franklin's rich intellect, and soon yields some fruits. Wherever these results have proved not strictly sound, his methods have at least been exemplary and entertaining. Who could now improve on this?—"I think it would be saving money to engage by a handsome salary some engineer . . . who has been accustomed to such business. . . . A single mistake thro' inexperience, in such important work, may cost much more than the expence of salary to an ingenious young man already well acquainted with both principles and practice."

Heat Technology

REGENERATOREN, REKUPERATOREN, WINDERHITZER: Die Waermerückgewinnung in Industriellen Ofenanlagen (Regenerators, Recuperators and Air Heaters). By *Werner Heiligenstaedt.* Verlag Von Otto Spamer, Leipzig, 1931. 345 pages. Price, 36 M.

Reviewed by W. H. MCADAMS

THIS volume on recuperators and regenerators is the fifth of a series on industrial furnaces, and its author, Dr. Heiligenstaedt, has previously contributed valuable papers on regenerator calculations. The derivations often are long, and the final equations complex, but the large number of charts and tables greatly reduce the labor of calculation. For example, the derivation of the equation for the over-all coefficient of heat transfer per period in regenerators occupies twenty pages, but numerical values for over-all coefficients are easily selected from tables which have been calculated from the complicated equation. The author derives equations for determining the effect of heat recovery on fuel consumption and combustion temperature, for pressure drop and draft loss in recuperators and regenerators, and for calculating flue-gas temperatures in the furnace. This method of calculating flue-gas temperatures in furnaces at various distances from the burner is unique, but some questionable assumptions made in the derivation make the final equation of doubtful value for general use.

This book contains considerable descriptive matter and a number of drawings, but its principal value lies in the development and application of quantitative methods of calculation for recuperators and regenerators. Detailed examples are given.

The discussion of heat transfer by convection is confined to those types occurring in recuperators and regenerators, principally heat transfer between solids and gases flowing inside tubes, outside tubes, and through checkerwork. The equations are simpler than the usual general forced convection equations, because they are intended to apply only to flue gas, fuel gas, and air. The treatment of radiation is very brief.

The author gives few references and no table of nomenclature. The latter is a serious drawback, since the reader must often search through many pages to find the meaning of the symbols used. Nevertheless, the book is a successful use of theoretical methods of attack at practical problems and thus is useful for the designer of equipment.

Protective Coatings

ROSTSCHUTZ - ROSTSCHUTZANSTRICH. By *Hermann Suida* and *Heinrich Salvaterra.* Julius Springer, Vienna, Austria, 1931. 344 pages. Price, 24 M.

Reviewed by E. L. CHAPPELL

THE authors have prepared a complete review of the literature on the subject of corrosion of iron and steel in the atmosphere and its prevention by protective coatings for the use of practical engineers who do not care to or are unable to assemble for themselves the information relating to this subject, which is to be found scattered through scientific journals and many trade publications.

A brief but broad discussion of the

general theory and mechanism of corrosion is followed by a brief treatment of metallic protective coatings. Drying oils, lacquers, pigments, dryers, and application of these coatings are then taken up in considerable detail. Sections on many of the newer synthetic coatings are included. An effort is made throughout to give the fundamental physical and chemical principles involved and to give basic explanations of phenomena such as hardening of coatings and progress of coating deterioration. The last third of the book takes up the testing of paints and protective coatings, particularly by exposure and laboratory tests of the finished products. Standard tests for raw materials and constituents also are discussed.

For the benefit of those who wish to follow further details of particular subjects, the original references are given, approximately 800 publications being referred to throughout the text and in the bibliography. Considerable use has been made of American as well as European papers and data. Photographic illustrations have been freely used and are valuable additions to the text.

Although intended as a summary for the practical engineer, this book will be found useful by those interested in the more general or theoretical aspects of the subject of rust-protective coatings and paints.

Water Control

EXAMINATION OF WATER. By *William P. Mason* and *Arthur M. Buswell*. Sixth Edition, 1931. John Wiley & Sons, Inc., New York City. 224 pages. Price, $3.

Reviewed by SHEPPARD T. POWELL

FOR more than thirty years Mason's work has been considered a standard text on this subject, and few books relating to water analysis have been so widely read. Much of this popularity has been due to the clarity of the text and to the author's simplicity in presentation of scientific facts. In the present edition the authors have wisely followed this same procedure and have retained much of the original data, which affords an invaluable historical background.

The book has been greatly enlarged by the addition of a number of essential analytical methods required by current water purification practice. As in the earlier editions, the text has been arranged in two parts. Four chapters are devoted to chemical analyses and one chapter to the bacteriological examination of water. Chapter four, relating to laboratory exercises for water treatment, should be of great assistance to students, engineers and chemists who possess no special training in water purification but who are faced with responsibility for the control of water-treating systems. The appendix contains many data pertinent to water analyses and water purification.

The "Report of the Advisory Committee on Official Water Standards" has been included in the present edition. The most valuable addition to the present edition is the discussion of the determination of the hydrogen-ion concentration of water and methods of analyses of boiler waters.

The Steel Chemist's Laboratory

CHEMICAL ANALYSIS OF IRON AND STEEL. By *G. E. F. Lundell, James Irwin Hoffman*, and *H. A. Bright*. John Wiley & Sons, Inc., New York City, 1931. 641 pages. Price, $7.

Reviewed by F. FENWICK

THIS book is an exceedingly comprehensive treatise on the analysis of iron and steel, including not only the determination of the common elements encountered in ferrous alloys but the special elements found rarely or in minute quantities, and the ores, refractories, and other materials entering into the manufacture of such alloys. Practically the whole field of inorganic analysis is covered. The book is written for the conscientious analyst without special previous experience but it is of great value to anyone interested in the composition of steel works products.

The authors have happily avoided making their book a collection of recipes, although it is primarily a compilation of methods which work. They devote much more space to discussion of the principles involved in their methods than to the experimental details, although the latter are presented with the greatest clarity, and they keep the reactions involved ever before the reader. One is convinced that the methods recommended have been tried by them not once but many times. The prospective worker is warned of pitfalls, the interfering elements are carefully stressed in each instance, and the solution of the special case indicated. The accuracy that may reasonably be expected of a given determination is continually emphasized and in the most outstanding cases considerable quantitative data are presented. The book may be termed an optimistic work in that it not only points the way to the avoidance of trouble but it lays many analytical bogeys.

It is true that for the most part the methods presented are those which have stood the test of time, but the student is introduced to the newer or less popular procedures by means of copious notes to the original literature. The authors have shown their wisdom in their almost complete avoidance of references to so-called "selected methods" employed in industry.

It may also be said that the authors are obviously not "potentiometric minded." The potentiometer indicator is rather pushed into the background, and its faults, which are far oftener inherent in the reaction involved than in the indicator itself, emphasized to the detriment of the beautiful scope and accuracy obtainable by such methods. The reader gets the impression that such potentiometric methods as are mentioned are not used by the writers, but potentiometry is not neglected in the notes, and the authors may be quite correct in their apparent assumption that these methods are not best suited to the reader they desire most to reach. In any event such criticism is distinctly minor, in view of the general excellence of the book. It is wholeheartedly recommended as a necessary addition to any live analytical library.

Chemical Histories

A HISTORY OF CHEMISTRY. By *F. J. Moore* and *William T. Hall*. Second Edition. McGraw-Hill Book Co., New York City, 1931. 324 pages. Price, $3.

A HISTORY OF THE BRITISH CHEMICAL INDUSTRY. By *Stephen Miall*. Ernest Benn, Ltd., London, 1931. 273 pages. Price, 10s., 6d.

FÜNFZIG JAHRE METALLGESELLSCHAFT, 1881-1931. By *Walther Dabritz*. Published by the Metallgesellschaft, Frankfurt, Germany, 1931. 303 pages.

PERHAPS chemical literature has "gone" biographical too. In any case, among the several histories in the field that have appeared lately, there is variety in the types represented. The Moore-Hall volume covers the entire career of chemistry from its beginnings to the present, necessarily in broad, concise terms. As a revision of a much earlier work, its treatment, dwelling on personalities and exceptional achievements, will be familiar to many; Dr. Hall has expanded and modernized certain portions, adding, quite fittingly, a sketch on Dr. Moore, who died in 1926. Altogether it constitutes a very readable and judicious survey, enhanced in appearance by plentiful illustrations.

In the second volume listed, the life of the British chemical industry is the object of a more confined biographic treatment. Appropriately, it was prepared on the occasion of the 50th anniversary of the Society of Chemical Industry, whose foundation itself was an event of the history covered. In this space it is impractical (as well as unnecessary) to check the historical details of the treatment, or to question the divisions of the book into separate chemical groups of disputable identity. The work is well planned, covers each industry from its scientific origins down to actual plants, and is equipped with bibliographies and a generous supply of good halftones. The name of the author will be guarantee, to many, of its competent style.

It remains, as in other recent cases, for the private enterprise to issue the story of its life in most resplendent form. The Metallgesellschaft commemorates its 50th birthday with a volume which for printing, binding, and photography must rank high in book-making craft. Furthermore, it draws on its widely known statistical service to illuminate the text with tables that throw a light on the last 50 years of the metals

industry. Bereft of immense foreign holdings during the War, the company is to be admired for this new testimony to its firm existence throughout a half century of varying ease and stress.

Domestic Gas Technology

AMERICAN GAS PRACTICE. Volume I—Production of Manufactured Gas. Published by the author, *Jerome J. Morgan*, 67 Salter Place, Maplewood, N. J., 1931. 969 pages. Price, $8.

Reviewed by R. S. MCBRIDE

LITERATURE on gas engineering which relates to American practice is so very limited that this volume by Prof. Morgan will be doubly welcome. It represents a serious effort to give a comprehensive picture of American practice with reference to the production of manufactured gas and is very successful in presenting a well-balanced story.

In its full title the book is called "a textbook," and it fully qualifies under this designation; the presentation is particularly suited to classroom and student use. But despite this distinctive application, the volume has great merit as a reference work for chemical engineers who have anything to do with solid fuel processing. In many cases the textbook character adds that elementary summary which is most welcome to one many years out of college. It gives in many cases elementary relationships or scientific facts that are all too hard to find in the more advanced engineering works of a reference nature.

Prof. Morgan has had advice and suggestions in the preparation of this work from a group of distinguished engineers designated by American Gas Association as an advisory committee. The author has, partly as a result of this cooperation and partly because of his personal wide acquaintance in the industry, presented an up-to-date, dependable work. It is strongly commended to any who wish to have either a reading or a reference volume on the subject covered.

Products of Research

SCIENCE IN ACTION. By *Edward R. Weidlein* and *William A. Hamor*. McGraw-Hill Book Co., Inc., New York City, 1931. 310 pages. Price, $3.

Reviewed by JAMES H. COLLINS

IN 287 pages of text, the authors of this book, both connected with the Mellon Institute of Industrial Research, have been limited to a sort of newsreel treatment. They start with the historic background of research in this country, and expound the scientific groundwork in mathematics, physics, chemistry, geology, biology, psychology, economics, and engineering, and then give the reader succinct chapters dealing with research in particular industries, and the application of research methods to mechanization, management, finance and personnel. An excellent discussion for the student and perplexed industrialist, but somewhat brief and cool for the general reader—including that general reader who is a business man, and who enjoys reading about the wonders of science as much as any other layman, but who comes to the scientist with his own set of questions.

For several years, the present reviewer has had contacts with a western laboratory, and frequently met the business man who says, "Yes, science is wonderful—but just what will it do for my business?" His next question is, "How much will it cost?" Then, "What kind of results will you guarantee?" When he hears the scientist's answers, very often the prospect of help from research seems too vague and expensive. But if he has courage, and goes ahead, then he wants to know, day by day, "How much longer is it going to take?" There is need for a book which will go into the difficulties of research, and its methods, and viewpoints, so that the business man may estimate its value to his own business.

In two or three years, there should also be material for another popular book on research, made up of material which is even now appearing: the results of work undertaken during the depression. Investigations now afoot should furnish many new wonder stories, and probably many of these stories will be set outside as well as inside laboratories, for science has been challenged to show its worth in human relations, and it will hardly fail to answer.

Chemical Leather Analysis

ANALYSIS OF LEATHER AND MATERIALS USED IN MAKING IT. By *John Arthur Wilson* and *Henry Baldwin Merrill*. McGraw-Hill Book Co., 1931. 512 pages. Price, $7.

Reviewed by VINCENT J. MLEJNEK

IN THEIR preface, the authors say "The object of this book is to give, in convenient form, working directions for the analysis and testing of leather and all the more important materials used in making leather; brief discussions of the principles upon which the methods of analysis are based; shortcomings of the methods; common sources of error and interpretation of the results obtained."

The book is frankly a compilation of methods in common use, but it is more than merely that, because it contains the comments of the authors on the methods and their interpretations of the results obtained. Owing to their broad experience and recognized high standing in the industry, their comments add greatly to the value and interest of the book. Considerable attention is given to analysis of the liquors used in the manufacturing processes in the beam house, tannery, and curry shop. Not only are the older methods of investigation given adequate attention but room is found for a rather complete discussion of the more modern tools and methods, such as the microscope, enzymes, bacteria, and hydrogen-ion concentration. A chapter also is devoted to methods for studying "Physical Properties of Leather," a subject in the investigation of which the authors were pioneers and which is attracting growing attention.

The book is of value not only because it makes accessible under one cover much information which anyone concerned with the study of leather must have but also because there appears at the end of each chapter a fairly extended set of references to articles relating to its subject matter. The book is clearly printed and should be a welcome addition to the library of anyone interested in leather and its making.

Corrections

To the Editor of Chem. & Met.:

Sir:—It is gratifying to read, in your editorial in the December number, that fire protection engineering is worthy of recognition as a profession. It is not at all gratifying to learn that *Chem. & Met.* does not know of the existence of a department of fire protection engineering, now in its 29th year, at Armour Institute of Technology.

The department offers a standard four-year engineering course, leading to the degree of Bachelor of Science in Fire Protection Engineering, which has thus far been conferred on 247 graduates. In recent years the average registration has been approximately 100. Naturally, the curriculum devotes to chemical subjects an amount of time which is second only to that required of chemical engineering students. The professional fire protection engineering work of the department includes two years of laboratory assignments at Underwriters' Laboratories. It is perhaps not necessary to give further details of the curriculum, but it is designed to provide broad engineering, training and to include special instruction regarding fire hazard, fire resistance, and fire extinction.

Our graduates, with practically no exceptions, are employed by organizations which are directly concerned with fire protection. The demand for them by the fire insurance business, in its testing laboratories, inspection bureaus, insurance companies, agencies, and brokerage houses has been such that practically none have been available for industrial occupations.

J. B. FINNEGAN,
Professor, Fire Protection Engineering.
Armour Institute of Technology
Chicago

A *Case of Misrepresentation*:—The pictures appearing in the article on the Shell Chemical Co., *Chem. & Met.*, November, 1931, pages 636-7, are found to be mislabeled. The two captions will read correctly as they stand if substituted for each other.

SELECTIONS FROM RECENT LITERATURE

FILTRATION. Max Dolch. *Chemische Apparatur,* Jan. 10: pp. 4-6. The relations between a filter medium and the apparatus and manner in which it is used are so intimate that no successful solution of practical filtration problems is possible without exercise of good judgment in all three aspects of the question. That is, the filter medium must be well chosen, the apparatus must be suitable for the medium and for the intended use, and the operation must be skillfully managed. Maximum total pore volume in the medium is important, for the sake of permeability to liquid, but impermeability to the smallest solid particles must not be sacrificed. It is not only the size but the configuration of the pores that governs permeability; indeed, the latter is the major factor. This explains why microscopic examination tells little about the actual performance of a filter medium; only actual tests will give a reliable verdict. Configuration is important also for cleaning a used filter medium; a filter cloth is easy to clean, as a rule; but the extra expense of dismounting the cloth and replacing it offsets its advantage in ease of cleaning as compared with a rigid medium which is cleaned in place. It is helpful to consider the ideal case of a filter layer made up of spherical particles, and to compare the pore configurations of cubical and tetrahedral packing of the particles. This is particularly important in connection with use of powdered filter aids, when the powder becomes the true filter and the original filter serves merely as a carrier. Proper choice and use of filter aids is one of the principal secrets of success.

FRACTIONATING COLUMNS. S. Libinson. *Chemische Apparatur,* Dec. 10; pp. 253-8. Calculations for the performance of bubble tray fractionating columns, when based on the assumption of physical equilibrium between liquid and vapor, give results for the "ideal" column; but this does not provide a true picture of actual operating results. Hence, in this investigation, a basis is sought for calculating the dynamic conditions representing the actual practical performance of a bubble tray fractionator. From known relations between the compositions of vapor and liquid over a given tray, an equation is derived which gives the number of trays required in a tower to produce a given effect. This equation, with certain assumptions, shows the number of trays required for the ideal fractionator, and in terms of known conditions permits calculation of the number for the actual operating tower. The use of the equation is illustrated by a sample calculation covering fractionation of a sulphate liquor containing 0.8 per cent ethyl alcohol, of which 97.5 per cent is to be recovered (that is, the concentration is to be lowered to 0.02 per cent by fractionation). A major advantage of the equation is that it can be used without the aid of graphic methods; this eliminates an important source of error for cases where the initial concentration of one component is very low.

ALUMINUM CORROSION-RESISTING ALLOY. Hans Wolf. *Chemische Fabrik,* Dec. 30; pp. 493-4. Although pure aluminum (99.5 per cent and higher) resists corrosion much better than the crude metal, its chemical stability is still inadequate for many uses, and its relatively low mechanical strength bars it from still other applications. An old opinion is to the effect that introduction of alloying metals necessarily lowers the corrosion resistance of very pure aluminum. Recent developments have proved that this is erroneous; but belief in its accounts for the production and use of Alclad, Allautal, and other high-strength alloys which are plated with pure aluminum as a protection against corrosion. Several binary alloys have been found to equal or surpass very pure aluminum in resistance to attack. Among the newest and least familiar improvements in this respect is the use of small quantities of manganese in very pure aluminum, permitting the usual tolerances with respect to quantity of impurities (iron and silicon) in the aluminum. One new binary aluminum-manganese alloy, containing less than 2 per cent of manganese, is considerably harder than 99 per cent aluminum and has a much higher tensile strength. Its resistance to corrosion also is much greater than that of pure aluminum, so that its service life is longer. This alloy is being successfully used for making kitchen ware, fermentation vats, chemical plant equipment, articles subject to sea-water exposure, roofing, foil, etc. It is anticipated that it will also find extensive application for plating various light metal alloys.

SOLVENT RECOVERY. J. C. Liddle. *Chemistry & Industry,* Jan. 1; pp. 3-4. The Bayer process, operated in Great Britain as the Carbo-Union process, makes use of two or more adsorbers, a condenser, and blowers to draw in the air and vapor. The machines and drying chambers, from which solvent vapors escape, are hooded and connected to the blowers. Adsorption is confined to a narrow zone which travels up the carbon as the lower layers become loaded. When the top of the zone is reached, the adsorber is switched out for regeneration, and another is switched in. Regeneration is effected by means of direct low-pressure steam; the resulting mixture of solvent vapor and steam is then condensed, or rectified if the solvent is water-soluble. The steamed carbon is dried with warm air and cooled with cold air. The cycle is then complete, and it is ready for a new charge. In the case of flammable solvents, proper precautions must be taken to prevent fire and explosions. Low fire hazard is one of the advantages of the active carbon process; since the highest temperature reached is only about 100 deg. C., there is relatively little risk. The system is being successfully applied in various countries, even in China with none but Chinese operators, in the manufacture of explosives, rayon, celluloid, coated fabrics, and other products. Barring factory and suction leakages, the recovery efficiency is about 98 per cent in actual factory operation.

RUBBER FOR CORROSION RESISTANCE. F. Kirchhof. *Gummi-Zeitung,* Jan. 8; pp. 497-8. For protecting metal, wood, or concrete equipment from atmospheric and chemical deterioration, highly chlorinated rubber has a number of advantages. Though chlorinated rubber has been known for many years, its successful adaptation to the protection of materials has been accomplished only in recent times. Owing to the very low prices of rubber and chlorine, and to modern low-cost production methods, this type of protective coating can now compete successfully with others. It provides a flame-resisting film, with excellent adhesion and high resistance to acids and alkalis; the mechanical strength and durability of the film are very satisfactory and the insulating properties give good protection against stray electric currents. When used as a paint, the hiding power and behavior toward pigments compare favorably with other paint materials. Solubilities in various solvents are briefly discussed. Chlorination increases the weight of the rubber by 200 per cent or more, as compared with about 100 per cent increase in making hard rubber.

GRINDING MILL CLOGGING. Walter Klenk. *Farben-Zeitung,* Jan. 9, p. 522. Stoppages in grinding, due to packing of the powder in certain parts of the mill, tend to occur oftener in modern automatic machines than in the older types. Preventive measures have not reached such a degree of perfection as to eliminate the need for skill and watchful care in operation of grinding machines, but there are certain mechanical devices which make it possible to prevent such stoppages. Where a bagging machine is attached to a mill, the worm conveyor and its outlets to bags should be arranged so that bars are filled successively along the conveyor trough, and there should be an automatically controlled outlet at the end of the trough to prevent powder from piling up in the end when all the bags in the row are filled. The inlet to the conveyor should also have an automatic release, operating in case the inlet becomes clogged. Similarly, when the mill discharges into

a screening machine, the inlet to the screen should have a release which will divert the powder and allow it to pile up on the floor in case of clogging. The extra outlets used for these release devices may be so arranged as to facilitate cleaning the inside of the machinery or clearing out clogged passages. Diagrams of some attachments are shown, with emphasis on one which is intended to protect the modern screening machines from overloading and other possible damage.

FLOTATION METHODS. Arthur F. Taggart. *Journal of Physical Chemistry*, January; pp. 130-53. Early studies of flotation processes were physical, largely because practical application originated in an engineering industry; but closer investigations have demonstrated that flotation phenomena are predominantly chemical. Empirical progress developed two groups of processes, the bubble-column type and the pulp-body type. There are many inventions of flotation machines, but they may be grouped in two principal classes: namely, the bubble-column and the agitation-froth machines. A third group, which includes the sub-aeration machines, is essentially a hybrid of the two main groups. Selective or differential flotation involves chemical reactions; e.g., in selective flotation of galena from its mixtures with sphalerite and pyrite, provision is made for formation of zinc cyanide on the sphalerite surface to prevent formation of zinc xanthate, and for protecting the pyrite (probably by a coating of insoluble ferro- and ferricyanides). Then only the galena reacts with the xanthate and is floated. There is sound experimental evidence of a direct relation between Brownian movement and floatability in ore pulps; if the mineral particles are in Brownian movement, collecting and frothing agents will not make them float. The observed facts do not agree with the classical theory of molecular bombardment as a cause of the Brownian movement. Numerous experiments are described to illustrate the chemical aspects of flotation, and expedients are discussed for preventing undesired particles from floating, and for floating particles which a given collector will not float. The cited experiments also support the principle that mineral flotation is entirely a matter of reaction possibilities and properties of reaction products.

LIQUID LEVEL INDICATORS. O. Teufert. *Farben-Chemiker*, January; pp. 20-3. For remote reading or control, something more elaborate is needed than a simple float device; in general, either a pneumatic or an electrical indicating apparatus is required. The pneumatic type of instrument, with a metal diaphragm in the submerged bell, which serves as the liquid level responsive member, can be made very sensitive. Pressure changes on the confined air within the bell are transmitted through a capillary, either to an indicating or a recording instrument at the place of observation. When "full" and "empty" signals are to be shown at a given place, or when the distance between the container and the place of observation is great, an electrical apparatus is needed. It is important in such devices that the level indication shall be continuous, not merely at intervals up and down the container, and that the instrument shall show whether the level is falling or rising. One type of electrical indicator has three signal lamps, red, white and green; in other systems, acoustical signals are used.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Copper. U. S. Tariff Commission Report No. 29, Second Series. 10 cents. Report to the U. S. Senate on difference in cost of production during calendar years 1928, 1929, and 1930 between the foreign and domestic articles provided for in paragraph 1658 of the Tariff Act of 1930.

Statistics Concerning Intoxicating Liquors. Bureau of Industrial Alcohol document issued as of December, 1931; 20 cents.

Formulas for Completely and Specially Denatured Alcohol. Bureau of Industrial Alcohol Appendix to Regulations 3, revised October, 1931; 5 cents. Valuable for all alcohol users.

Code of Lighting: Factories, Mills, and Other Work Places, Revision of 1930. Bureau of Labor Statistics Bulletin 556; 15 cents.

Abridged Volume Correction Table for Petroleum Oils. Supplement to Bureau of Standards Circular 154; 5 cents.

Zinc and Its Alloys. Bureau of Standards Circular 395; 70 cents.

Survey of Fuel Consumption at Refineries in 1930, by G. R. Hopkins. Bureau of Mines Report of Investigations 3145; mimeographed.

Fractionation of American Gum Spirits of Turpentine and Evaluation of Its Pinene Content by Optical Means. U. S. Department of Agriculture Technical Bulletin 276; 5 cents.

Bindery Adhesives, by B. L. Wehmhoff. U. S. Government Printing Office Technical Bulletin 14.

Effects of Pulp Mill Pollution on Oysters, by A. E. Hopkins and others. Bureau of Fisheries Bulletin 6; 30 cents.

Bag, Case, and Strap Leather. Bureau of Standards Commercial Standard CS34-31; 5 cents. A record of the standards approved by the industry.

Properties of Fiber Building Boards, by C. G. Weber and others. Bureau of Standards Miscellaneous Publication 132; 5 cents.

Methods and Apparatus Used in Determining Gas, Coke, and Byproduct Making Properties of American Coals, by A. C. Fieldner and others. Bureau of Mines Bulletin 344; 40 cents.

Aluminum Trade of Germany and Switzerland, by Consul Sydney B. Redecker. Bureau of Foreign and Domestic Commerce Minerals Division Special Circular 21; mimeographed.

Tourmaline, by I. Aitkens. Bureau of Mines Information Circular 6539; mimeographed.

Production of Explosives in the United States During Calendar Year 1930. Bureau of Mines Technical Paper 509; 10 cents.

Petroleum Refineries in Foreign Countries, 1931. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 784; 10 cents.

World Retail Gasoline and Kerosene Prices. Bureau of Foreign and Domestic Commerce Minerals Division Special Circular 23; mimeographed.

Chemical Consumption by the Canadian Paper Industry, by Avery F. Peterson. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 362; mimeographed.

Dyes and Textile Chemicals in Czechoslovakia, by Sam E. Woods. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 360; mimeographed.

Belgian Zinc Industry, by Leigh W. Hunt. Bureau of Foreign and Domestic Commerce Minerals Division Special Circular 22; mimeographed.

Market for Marine Animal Oils in the United States, by Roger W. Harrison. Bureau of Fisheries Investigational Report 7; 15 cents.

Commercial and Industrial Organizations of the United States, Revised Edition, 1931. Bureau of Foreign and Domestic Commerce, Domestic Commerce Series 5; 85 cents.

Improvement in the Production of Oleoresin Through Lower Chipping, by Eloise Gerry. U. S. Department of Agriculture Technical Bulletin 262; 15 cents.

Fertilizers for Cotton Soils, by J. J. Skinner. U. S. Department of Agriculture Miscellaneous Publication 126; 5 cents.

Mechanical Application of Fertilizers to Cotton in South Carolina, 1930, by G. A. Cumings and others. U. S. Department of Agriculture Circular 192; 10 cents.

Boron in Irrigation Waters, by Carl S. Scofield and L. V. Wilcox. U. S. Department of Agriculture Technical Bulletin 264; 20 cents.

Manganese and Other Less Common Elements Have Fertilizer Value. U. S. Department of Agriculture Yearbook, Separate 1210.

Federal Specifications. Issued by Federal Standard Stock Catalog Board as follows: Cold-application tar for roads; refined construction tar for roads; refined hot-application tar for roads; repair-work tar for roads; molded rubber packing and gaskets in sheets and strips; asphalt for road and pavement construction; red-lead, dry and paste-in-oil. 5 cents each.

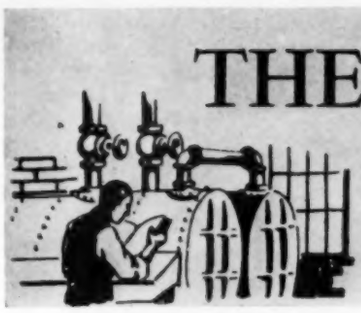
Census Data. Printed pamphlets giving data for commodities and groups of commodities from the census of industrial operations for 1929 are now available for the majority of the industries covered by the Census of Manufactures. Corresponding reports for the Census of Distribution are appearing by industries in preliminary form. Final printed pamphlets from the Distribution Census are available only to a limited extent by states; not yet by industries.

Statistical Abstract of the United States, 1931. Bureau of Foreign and Domestic Commerce bound volume; $1.25. A digest of data collected by all statistical agencies of the government as well as those of a considerable number of private agencies and several states.

Mineral Production in Alaska in 1931. Department of the Interior press release in mimeographed form dated Jan. 1, 1932.

Minerals Production Statistics for 1931—preliminary mimeographed statements from the Bureau of Mines on: copper, zinc, lead, iron ore, slate, and phosphate rock. Similar surveys by states are available for a few of the mineral-producing areas.

Minerals Production Statistics, 1930—final printed separates from the Bureau of Mines on: Tungsten, by Frank L. Hess, 5 cents; Chromite, by Lewis A. Smith, 5 cents; Secondary Metals, by J. P. Dunlop; Bauxite and Aluminum, by C. E. Julihn, 5 cents; Slate, by Oliver Bowles and A. T. Coons, 5 cents; Asphalt and Related Bitumens, by A. H. Redfield, 10 cents; Pennsylvania Anthracite, by Ellery B. Gordon and H. L. Bennit, 10 cents; Clay, by Jefferson Middleton and K. V. Herlihy, 5 cents; Iron Ore, Pig Iron and Steel, by Hubert W. Davis, 10 cents; Magnesium and Its Compounds, by Paul M. Tyler, 5 cents; and Vanadium, Uranium, and Radium, by Frank L. Hess, 5 cents.



THE PLANT NOTEBOOK

Air Lift Nomograph

By D. S. Davis
Appleton Vocational School
Appleton, Wis.

IN CONNECTION with air-lift operation it is frequently necessary to calculate the volume of free air—i.e., air at atmospheric temperature and pressure—required to raise 1 gal. of water through a certain distance when the depth of water above the air inlet is known.

This calculation may be readily made by means of the accompanying alignment chart which solves the equations:

$$S = \frac{100\ H}{h + H}$$

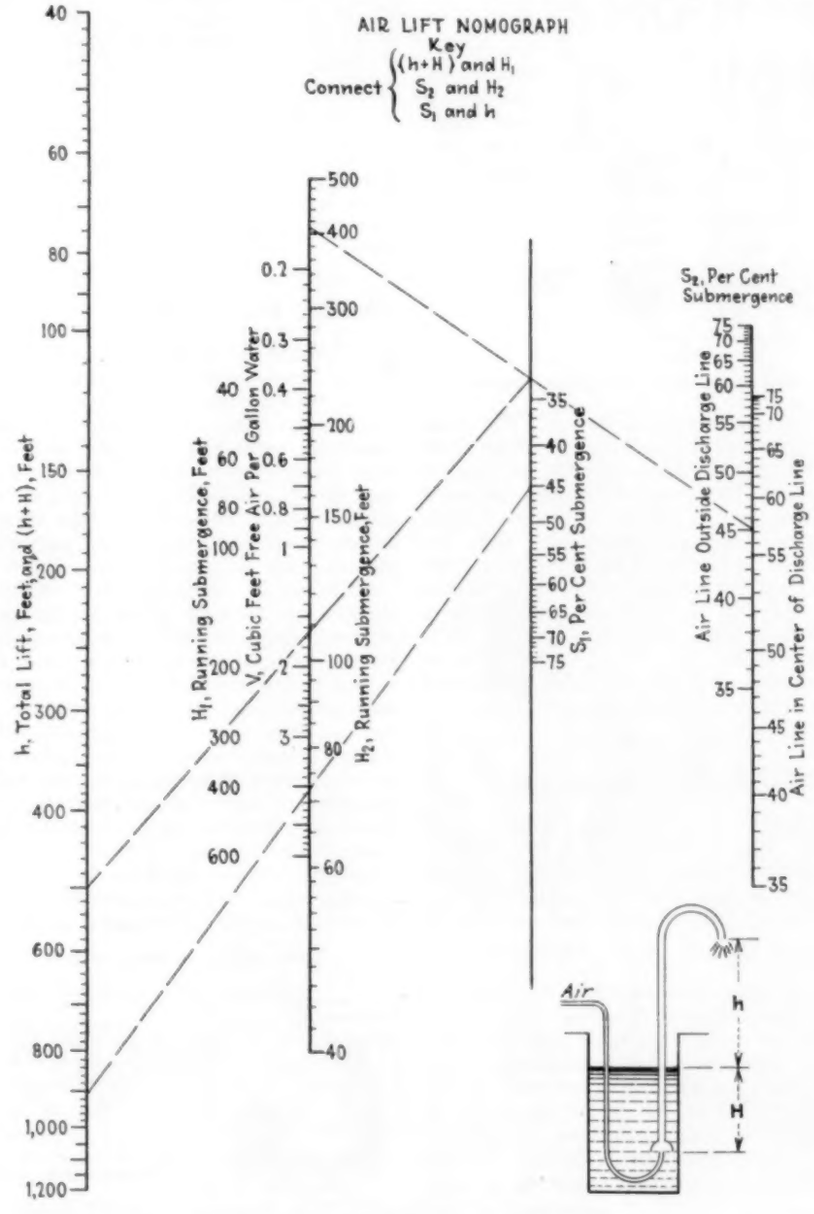
$$\text{and } V = \frac{h}{C \log \frac{H + 34}{34}}$$

where h is the total lift in feet or distance from the surface of the water to the discharge outlet; H is the running submergence in feet or depth of water above the air inlet (see sketch); S is the percentage submergence; C is a value depending upon the percentage submergence and the position of the air inlet pipe; and V is the volume of free air in cubic feet required for 1 gal. of water. C assumes the values given in the tabulation.

Values of Air-Lift Constant

S, Percentage Submergence	Values of C*: Air Line Outside Discharge Pipe	Air Line Inside Discharge Pipe
35	216	162
37	...	171
40	246	185
45	272	204
50	296	228
55	318	262
60	335	285
65	348	306
70	358	322
75	366	330

*Ingersoll-Rand Air Lift Catalog, No 77, p. 15.



The broken lines illustrate the use of the chart when the running submergence is $H = 410$ ft., the total lift is $h = 500$ ft., and the air line is outside of the discharge pipe. Connect $h + H = 910$ with $H = 410$ on the H_1 scale and project the line to meet the percentage submergence scale, S_1, in the value $S = 45.1$ per cent. Connect 45.1 on the S_2 scale with 410 on the H_2 scale and note the intersection with the S_1 axis. Connect this latter point with 500 on the h scale and read V as 1.65 cu.ft. of free air per gallon of water.

❖

Laying Wood-Block Floors

A RECENT issue of the *General Electric Review* carried an article by O. B. Bemis which described an unusual and effective method of laying wood-block floors. In the usual method, a thin layer of molten pitch is allowed to cool and harden on the concrete underfloor before the blocks are laid. After the blocks are placed, a layer of molten pitch is applied to the floor surface so as to penetrate the cracks and effect a bond.

In the new method, a $\frac{1}{16}$-in. layer of pitch is spread on the floor, after which ordinary, non-galvanized "chicken wire" is laid on the pitch and rolled flat. The blocks are then laid and the passage of an electric current through the wire netting melts the pitch and makes a strong bond without pitch-coating of the floor surface. The floor is rolled, the current disconnected, and the floor allowed to cool for 24 hours. Wood floors themselves have sufficient acid resistance for many purposes. Where a chemical tile floor is called for, it seems probable that the same laying method can be used.

EQUIPMENT NEWS
FROM MAKER AND USER

1931 Electrical Trends

By J. V. Alfriend
Chemical Engineer
Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

DURING 1931 a number of tendencies in electrical equipment for process use became evident. One was the increasing interest in the use of load-regulating, load-limiting, and peak-load warning equipment. Load-regulating equipment can be used only in those industries which, through voltage or pressure control of one division of a plant, can compensate for uncontrollable irregularities of another division. Such a condition is represented by an electrolytic plant where the d.c. energy can be controlled by varying the d.c. voltage and thus compensating for variations in the a.c. energy of the process section.

In load limiting certain predetermined machines are disconnected from the line when demand tends to go above a predetermined point. Such machines are manually or automatically restarted when total plant demand reaches a predetermined lower limit. Electric water heaters are sometimes so used to assist the boiler plant when electric energy is available below minimum power limits.

Considerable study and some progress was made in the field of magnetic separation of non-ferrous materials, and in the electrostatic separation of non-magnetic materials. In the electrostatic precipitation of dust, several installations were completed utilizing vacuum tube rectifiers to obtain high-voltage unidirectional current instead of the time-honored synchronously driven commutator or mechanical rectifier.

Photo-sensitive devices were used with increasing success. The phototube has become a useful tool in obtaining accurate control in processes where variations in content effect in like measure variations in properties of light reflection and refractive index.

With electrically non-conducting liquids uninsulated heaters immersed in the liquid or used as the lining of the container were successfully employed to obtain high heat flow at low temperature gradient. Electricity was applied increasingly in heating liquids, particularly to obtain higher rates of flow of the liquid, higher temperatures, and faster response to temperature control.

❖

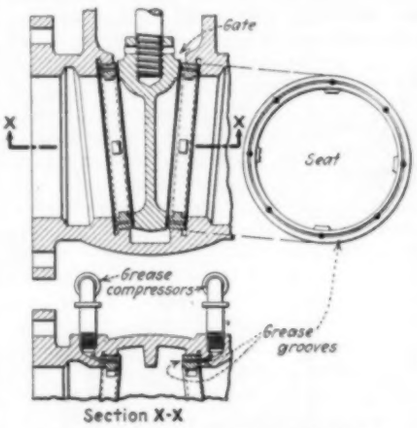
Disk Fan Heater

ALL-ALUMINUM, solid-welded construction has been employed by the Niagara Blower Co., 6 East 45th St., New York City, in a new disk-fan heater of the extended-surface-tube type. The heater may be provided either with an aluminum or a copper core. It is designed to operate on steam pressures up to 150 lb.

❖

Lubricated Gate Valve

LUBRICANT sealing between the seating surfaces of a gate valve has been provided in the "Lubrotite" gate valve manufactured by the Reading-Pratt & Cady Co., Bridgeport, Conn. How this is accomplished is indicated in the accompanying drawing. The seats are grooved circumferentially both front and rear, the latter groove serving to conduct lubricant from the pressure reservoirs to a number of holes through the seat which communicate with the groove in contact with the disk. As a result of the lubrication, the valve is said to operate much more easily than a non-lubricated valve and to seal tight even when the seating surfaces have been damaged. Valve sizes correspond to those for non-lubricated valves.



Details of Gate Valve Lubrication

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Metallic Heat Insulation

RESISTANCE to heat transfer, equal to that of the best cork, is said to be obtainable with an insulating material made of aluminum foil which has recently been introduced into the United States by the Alfol Insulation Co., Chrysler Bldg., New York City. This use of aluminum was first developed in Germany and was based on observations of many years' standing that the very high reflectivity and permanence of the reflecting surface of aluminum would cause the metal to serve admirably as a means of creating a dead air space of the type required in insulation. It was found that insulation made up of successive layers of the foil, either held apart by insulating separators or by crumpling the foil, stood up indefinitely against severe vibration, that it was moistureproof, vermin-proof, and resistant to industrial fumes and vapors. Numerous applications of Alfol insulation were made in European ships, refrigeration plants and refrigerated cars. The material was used also to insulate steam piping, boilers and diesel engine exhausts. It was found to be usable satisfactorily from very low temperatures to about 1,200 deg. F.

Alfol insulation is extremely light, weighing only about 3 oz. per cubic foot. The foil used may be as thin as 0.0003 in. As installed, the layers of foil are placed at intervals of about $\frac{1}{8}$ in., and under these circumstances, thickness for thickness, have been found by several investigators to give as efficient insulation as cork, or somewhat better. For many purposes the crumpled foil is equally satisfactory and easier to install. For higher temperatures, however, the form using flat foil sheets and separators has a somewhat higher insulating effect.

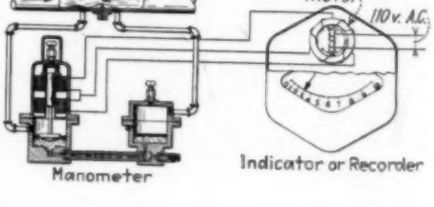
❖

Electric Flowmeter

INSTEAD of the divided coil generally used in the indicating instruments of inductance-bridge flowmeters, the new Oriflo electrically operated flowmeter introduced by the Builders Iron Foundry, Providence, R. I., makes use of a self-synchronous motor to actuate the indicator or recorder mechanism. Operation of the instrument is indicated in the accompanying sketch. Variations in mercury level in the manometer, brought about by changes in flow through the orifice, are measured by the position of the iron core attached to the mercury float. When the core moves from its central position in the divided coil, it unbalances the bridge circuit, which is connected to an a.c. source. Immediately the self-synchronous motor in the indicator reflects the position of the manometer float, indicating rate of flow.

Instruments are available in both indicating and recording models. The latter are regularly supplied with an

Arrangement of Oriflo Meter



integrator. It is claimed for the meter that it is accurate, capable of remote installation at practically any distance, and that voltage variation introduces no error.

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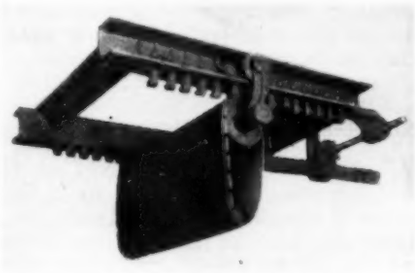


Partially Opened Gate

Apron-Type Gate

EASE OF OPERATION is the principal feature of a new apron-type gate manufactured by the Stephens-Adamson Mfg. Co., Aurora, Ill. This gate is shown in the accompanying illustration to consist of a series of reinforced crossbars, covered with a wear-resisting rubber apron which prevents spillage. A rack and pinion, driven by hand- or by chain-wheel, moves an operating carriage backward and forward to open and close the gate. When closed, the apron is supported by hooks which are moved out of the way by a cam as the carriage moves to open or close the opening.

❖

Feed-Water Controller

BOILERS having a high steaming rate give level indications which fail to express the true quantity of water in the drum, because of the considerable percentage of the volume below the surface which is occupied by steam. To overcome this difficulty and to provide an accurate means of feeding water at a rate proportional to the demand, the Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, Ohio, has developed a new controller which takes into account the effect of the "swell" and the rate of steam output and water input. Three manometers of the Bailey mercury-bell type are coupled together with linkages and serve to control a Selsyn transmitter and in turn to control the feed-water regulating valve through a torque amplifier. One manometer measures the water level in the boiler drum. A second measures steam flow rate and the third measures water flow rate as determined by orifices. The result of this type of control is said to be the maintenance of a substantially uniform weight of water in the boiler rather than a uniform level.

❖

Hard-Facing Material

FOR RESISTANCE to especially severe abrasion, as is encountered in high-speed tools, shovel teeth, grinding shafts and so on, a black, granular grade of tungsten carbide, known as Blackor, has been introduced and is being marketed in the United States by the Lincoln Electric Co., Cleveland, Ohio. This material is applied with a carbon arc and is used to cover the entire abrasion surface. Blackor has the tensile strength of steel, a scratch hardness of more than nine, and maintains its abrasion resisting qualities at a red heat. One ounce covers 3 to 4 sq.in.

❖

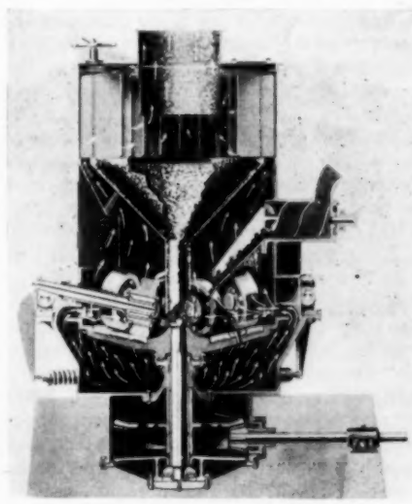
Absolute Pressure Recorder

TO AVOID the necessity for barometric corrections in accurate vacuum measurement, the Bristol Co., Waterbury, Conn., has introduced a new direct-reading, single-pen, absolute-pressure gage, for use with condensers, vacuum pans, vacuum stills and similar equipment. Two sensitive diaphragm elements, one measuring barometric pressure and the other vacuum, transmit their motion to a single pin through a differential linkage. Instruments can be furnished for ranges as low as 0-50 mm. of mercury absolute pressure.

❖

Table-Roller Pulverizer

GRINDLE Fuel Equipment Co., Harvey, Ill., has introduced an improved Bethlehem-type pulverizer. The machine is similar in principle to earlier pulverizers of this type, but embodies a number of important changes in design. These include a new variable-speed, screw-type feeder, improved bearings, improved dust seal between the shaft and the grinding table, and a more efficient lubricating system which operates on all bearings while the machine is in operation. The grinding track is now made in one piece. It is claimed for the improved unit, which is built in three sizes, for capacities from 3 to 12 tons of coal per hour, that



Improved Table-Roller Pulverizer

the output can be efficiently varied over a very wide range; that the power consumption is very low; and that the use of air separation insures a uniform product, as fine as 325 mesh. Although developed primarily for coal pulverizing, the maker claims equal grinding efficiency on most other materials.

High-Speed Gear Unit

STANDARD speed-reduction units for speeds up to 6,000 r.p.m. on the high-speed shaft, and capacities from 120 to 2,500 hp., with ratios up to 10 to 1, have been announced by the Farrell-Birmingham Co., Buffalo, N. Y. These units are suitable also for increasing speed. The gears are of the Farrell-Sykes herringbone, continuous-tooth type and are said to be cut with extreme accuracy. All units are provided with efficient lubricating systems with pump feed to all bearings. Gears are lubricated by spray. Oil coolers are provided when necessary.

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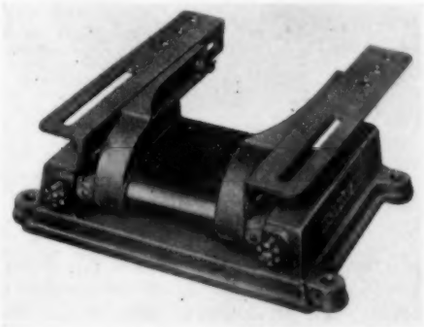
Improved Motor Drive

ADAPTABILITY to motors of any sort, old or new, single or polyphase, a.c. or d.c., or for any number of cycles, is possible with an improved



Rockwood Adjustable Motor Base

short-center drive recently announced by the Rockwood Manufacturing Co., Indianapolis, Ind. The principle of the drive is similar to that of the earlier one described on page 358 of the June, 1931, issue of *Chem. & Met.*, in that the weight of the motor is used to apply tension to the belt. However, as appears from the illustration, the mounting arms are adjustable to any sort of motor base. In addition, the angles to which the motor is bolted are adjustable lengthwise, so as to vary the distance from the center of gravity of the motor to the pivot. In this manner any degree of tension required may be applied to the belt. It is asserted that this feature reduces wear of the belt, pulley and motor to the minimum, and reduces power consumption to that actually required by the driven machine.

❖

Improved Roller Chain

TO INSURE uniformity of pitch throughout the life of roller chain, the Morse Chain Co., Ithaca, N. Y., has developed a new construction in which no movement under load occurs between the roller and the joint members. Within the roller there are two joint members, a segmental bushing and a pin. The cross-section of the pin is that of a round pin integral with a segmental bushing. On account of this construction, when a chain is flexing on or off a

sprocket, all sliding movement of surfaces under load is between the pin and its bushing. These chains are made to manufacturers' standards and are interchangeable on all standard roller sprockets.

❖

Time Controller

CONTROL of temperature or pressure in relation to time is accomplished by a new instrument developed by the Foxboro Co., Foxboro, Mass. The instrument does not record. In place of the paper chart it employs a

Non-Recording Time Controller

printed aluminum cam which is cut for any desired temperature or pressure cycle. A cam follower attached to the control pointer follows the edge of the cam and maintains control at the desired setting.

Foxboro Co. has also developed what is known as the new "Anti-Ambi" recording thermometer. This instrument is said to be unaffected by ambient temperatures of the case and tubing and to give true bulb temperatures under all conditions. No cams, compensating levers, bimetallic strips, or retarding actions are used and the thermometer is designed to employ a sensitive bulb as small as 1 in. in length.

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Lead Coating in Field

IMPROVEMENT in its methods of homogeneous lead coating, embodied in the new "Leadhesion" process, has permitted the Gross Engineering Corp., 3955 West 25th St., Cleveland, Ohio, to handle both large and small work in the field as readily as in the shop. The coatings produced by this method are said to be particularly applicable to large equipment, moving parts such as agitators, and to apparatus for particularly severe service.

❖

Tension Indicator

DETERMINING the tension in cables of all kinds is possible with a new tension indicator recently introduced by the Martin-Decker Corp., 3431 Cherry Ave., Long Beach, Calif. The device is attached to the cable by two clamps, while a third contact permits deflecting the cable slightly. The force required to produce this deflection is transmitted hydraulically to a pressure gage calibrated in terms of tension in the cable.

This company has also developed a small pulsation dampener for the protection of pressure gages. One size of dampener is said to be suitable for any pressure and for most liquids and gases. Dampeners are available in brass with a Stainless steel stem, or constructed entirely of Stainless steel.

❖

Lubricated Plug Cock

NOVEL means are employed in a new design of lubricated plug cock to free the plug prior to turning. According to the Chapman Valve Manufacturing Co., Indian Orchard, Mass., designer and manufacturer of the cock, this is accomplished by purely mechanical means and does not depend on pressure of the lubricant. And as the plug is ground and lapped into place, the cock does not depend on the lubricant for tightness. Lubrication is used only for ease in operation.

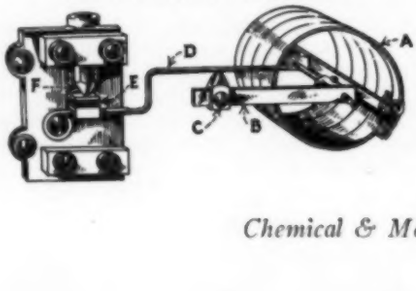
In turning the stem, the first effect is to lift the plug a small but definite amount to gain clearance. In this position the grease seal is said positively to prevent the entrance of foreign material between the plug and the body. Once the plug is raised, further turning of the stem rotates the plug and opens the cock. In closing, the plug automatically follows the reverse cycle. Cock sizes range from 2 to 30 in. for pressures as high as 500 lb. Both standard and Venturi designs are made.

❖

New Pressure Controller

PRESSURE CONTROL in the range from 0 to 5,000 lb. may be accomplished by a new non-indicating pressure controller recently put on the market by the Neilan Co., Ltd., 641 Santa Fe Ave., Los Angeles, Calif. The controller may be readily adjusted to any setting within its range by means of an outside milled screw which moves a pointer over a setting scale 4¼ in. long. The mechanism consists of a helical pressure spring which operates an air leak through a compound lever. This mechanism is illustrated in the accompanying drawing. Spring *A* actuates arm *B*, which carries adjustable wedge *C*. Depending on the position of this wedge, any desired movement of lever *D* can be obtained for a given movement of *A*. Thus the control effect may be adjusted for any desired point in the range. *D* carries the nozzle seat *E*, which, in its movement, opens or closes the air nozzle *F*. Pressure in the air line so controlled is communicated to a diaphragm-operated pilot valve which, in turn, operates the control valve.

Pressure Control Mechanism



The instrument is said to be highly accurate on account of this unique construction, and long-lived because of the use of special corrosion-resisting materials of construction.

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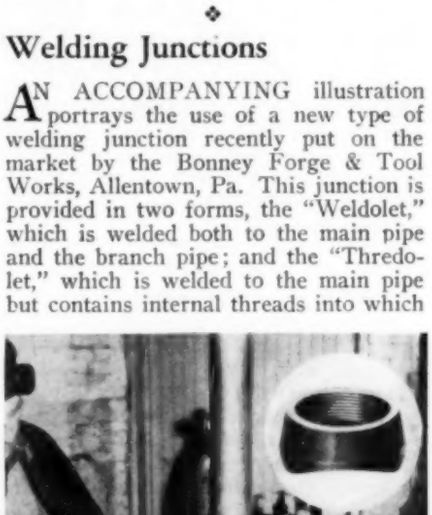
Short-Radius Fittings

INSTEAD of using a radius of 1½ times the diameter, as in its earlier series of weld fittings, Tube-Turns, Inc., Louisville, Ky., has put out a new series, the radius of which equals the pipe diameter. The new fittings, which include 45- and 90-deg. elbows and 180-deg. return bends, in sizes from ¾ to 20 in., are made with the same inside diameter and the same wall thickness and tolerance as the pipe with which they are used. The fittings are seamless and, according to the manufacturer, are very readily welded into the line.

❖

Welding Junctions

AN ACCOMPANYING illustration portrays the use of a new type of welding junction recently put on the market by the Bonney Forge & Tool Works, Allentown, Pa. This junction is provided in two forms, the "Weldolet," which is welded both to the main pipe and the branch pipe; and the "Thredolet," which is welded to the main pipe but contains internal threads into which



"Weldolet" Welded in Position; Insert: "Thredolet"

the branch pipe may be screwed. These fittings are drop-forged and are said to be very strong and readily weldable.

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Tin-Plated Toncan

REPUBLIC STEEL Corp., Youngstown, Ohio, has announced a new product which it has developed: tin-plated Toncan Iron. According to the manufacturer, this product is the only tin-plate with a rust-resisting base which is on the market at present. This product can be supplied in all base weights and sizes. Among the suggested uses are containers for chemicals and cases for gas meters.

Photoelectric Relay

FOR very rapid photoelectric control the General Electric Co., Schenectady, N. Y., has introduced relay CR-7505-G-5, which makes use of a Thyratron tube to control the output current instead of a mechanical relay. A small contactor built into the relay may be used to control larger output current than can be handled by the Thyratron. The relay consists of a photoelectric tube, a Pliotron for amplification, and the Thyratron and contactor. The device is built for operation on 110-volt, 60-cycle circuit.

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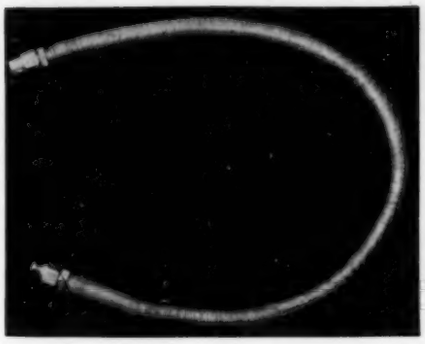
All-Steel Gage

FOR HEAVY DUTY at high pressure in steam and chemical plants, Crosby Steam Gage & Valve Co., 30 Church St., New York City, has developed the Style AIH all-steel gage, the bourdon tube of which is completely machined from a solid bar of special alloy steel. The gage is said to be made with great accuracy; and to insure retaining this accuracy, it is supplied with Stainless steel bearings and chromium-plated gearing.



Length of Seamless Aluminum Hose

Seamless Aluminum Hose

SEAMLEX CORP., 1028-47th Ave., Long Island City, N. Y., has announced the development of 5-ft. lengths of flexible seamless aluminum hose of 1 in. inside diameter. The hose is made of helically corrugated, specially tempered aluminum, and is provided with solderless and packless Duralumin end couplings. The exterior is protected by a strong, closely wound aluminum wire. The hose is recommended for use in handling nitric acid.

Manufacturers' Latest Publications

Air Filters. Northern Blower Co., West 65th St., Cleveland, Ohio—4-page folder describing recent improvements in continuous-operating air filters made by this company.

Alloy Pipe and Tubes. National Tube Co., Frick Bldg., Pittsburgh, Pa.—40-page book covering the properties and uses of Stainless and heat-resisting pipe and tubes made by this company.

Chemicals. Columbia Alkali Co., Empire State Bldg., New York City—26 pages on liquid caustic soda, explaining its properties, the savings through its use, and equipment for its handling. Gives many useful tables.

Chemicals. Eastman Kodak Co., Rochester, N. Y.—January, 1932, Price List No. 23—List prices of numerous organic chemicals made by this company.

Chemicals. Harshaw Chemical Co. of New York, Inc., 405 Lexington Ave., New York City—Small package price list of chemicals, including specialized chemicals for textile and agricultural uses, and a general list of standard industrial chemicals.

Chemicals. Pfanstiehl Chemical Co., Waukegan, Ill.—1930 catalog of rare sugars, amino acids, laboratory reagents and biochemicals.

Chemicals. Roessler & Hasslacher Chemical Co., Empire State Bldg., New York City—Publications as follows: 15-page book on the properties and uses of sodium perborate; folder describing the uses and properties of trichlorethylene and other non-flammable solvents.

Chemical Stoneware. General Ceramics Co., 71 West 35th St., New York City—Publications as follows: 14-page reprint entitled "Chemical Stoneware," by Dr. Felix Singer, describing properties and manufacture of chemical stoneware; also leaflets describing chemical stoneware equipment including suction filters, H_2S generators and valve-plug lifters; also folders on other chemical stoneware including valves, towers, storage vessels, blowers and exhausters.

Concrete. Barnsdall Tripoli Co., 2111 Railway Exchange Bldg., St. Louis, Mo.—Bulletins F and G—Respectively 2 and 16 pages, describing the use of Barnsdall Admix as a workability agent and integral waterproofing for concrete, mortar, stucco and cement products.

Condensers. Thermal Engineering Co., 701 Spring Arcade Bldg., Los Angeles, Calif.—4-page folder on multipass desuperheater-type shell-and-tube ammonia condensers made by this company.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-86B, single-phase directional overcurrent relays; GEA-841B, magnetic switch; GEA-924B, indoor bus supports; GEA-1084A, plate-type field rheostats; GEA-1192A, galvanized beam clamps; GEA-1236A, Fabroil gears and gear blanks; GEA-1242A, Textolite gears and gear blanks; GEA-1308, A.C. steam-engine-driven generating sets; GEA-1314A, induction time relays; GEA-1438, automatic Telemetering equipment; GEA-1442, dead-front air circuit breakers; GEA-1497, terminal boards for small wiring; GEA-1505, flood lighting for outdoor construction.

Electric Furnaces. Ajax Electrothermic Corp., Trenton, N. J.—Bulletin 7—22-page catalog on laboratory and small-production-scale coreless electric furnaces of the high-frequency type. Describes several new furnaces and gives information on refractories.

Equipment. Federal Electric Co., Signal Division, 1800 South 8th St., Chicago, Ill.—8-page catalog describing electric sirens for plant signalling.

Equipment. Sowers Mfg. Co., 1302 Niagara St., Buffalo, N. Y.—Catalog No. 8—39 pages on Dopp seamless jacketed and single-shell kettles, mixers, soap crutches, vacuum and pressure apparatus for heating, cooling and mixing.

Gas Pumps. International-Stacey Corp., Connorsville, Ind.—Bulletin 31-B10—4 pages on Victor-Acme rotary gas pumps made by this company.

Heat Transfer. Alco Products, Inc., 220 East 42d St., New York City—Bulletins 1012, 1013, and forms 201 to 216 incl.—Describe numerous types of heat transfer equipment for petroleum and natural gas industries. Form 206 describes in detail this company's "Lock-Forged" construction of heat exchangers in which castings and circumferential welds of flanges have been eliminated through the use of rolling, pressing and forging.

Instruments. Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio—Bulletin 192—8 pages on specific gravity recorders for liquids, describing also automatic control of gravity.

Instruments. Nielan Co., Ltd., 641 Santa Fe Ave., Los Angeles, Calif.—Bulletin 3060-B—16-page catalog describing a new non-recording temperature controller made by this company.

Lubrication. Acheson Oildag Co., Port Huron, Mich.—Technical Bulletin 200.2—4-page folder explaining the mechanics of lubrication with colloidal graphite.

Materials Handling. Jeffrey Mfg. Co., Columbus, Ohio—Catalogs 525 and 530—Respectively 46 pages on steel-thimble roller chains; and 51 pages on portable handling, loading and elevating equipment.

Metals and Alloys. Aluminum Co. of America, Pittsburgh, Pa.—64-page book with tabular data describing properties and uses of aluminum and its alloys.

Metals and Alloys. American Stainless Steel Co., Commonwealth Bldg., Pittsburgh, Pa.—Handsomely illustrated booklet describing the properties and range of uses of Stainless steels.

Metals and Alloys. Doehler Die Casting Co., 386 Fourth Ave., New York City—Folder describing the properties of "Brastil" brass alloy die castings with strength equal to steel.

Metal Protection. Skybryte Co., 1919 East 19th St., Cleveland, Ohio—Folder describing "Rust-Tox," a coating material to be used clear or pigmented for the protection of metal surfaces against rust. It is said to prevent further deterioration of surfaces already rusted when it is applied.

Mixers. Blaw-Knox Co., Pittsburgh, Pa.—Form 1326—12 pages on turbine-type mixers of many kinds made by this company.

Motors. Lincoln Electric Co., Cleveland, Ohio—Vol. 1, No. 1.—New house organ called "The Motorizer," published for those interested in a.c. induction motors.

Motors. Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo.—Bulletins 167 and 173, concerning respectively polyphase squirrel-cage motors and repulsion-induction motors.

Motors. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Leaflet 20536—4 pages on induction motors with integral speed reducers for speeds from 1550 to 69 r.p.m., ½ to 15 hp.

Paper Mill Equipment. Lobdell Car Wheel Co., Wilmington, Del.—30-page book on the grinding, care and upkeep of paper-mill rolls.

Pumps. Domestic Engine & Pump Co., Shippensburg, Pa.—Bulletins NI-31 and RI-31—Describing respectively industrial centrifugal pumps and self-priming centrifugal pumps for low and medium high heads.

Pumps. The LaBour Co., 111 Sterling Ave., Elkhart, Ind.—Bulletin 37—8 pages on a new series of close-coupled, self-priming centrifugal pump for non-corrosive service.

Pumps. Morris Machine Works, Baldwinville, N. Y.—Bulletins 140-143 incl.—Describe the general line of centrifugal pumps made by this company and explain in detail sand and dredging pumps, hydraulic dredges and dredge accessories.

Pump Primers. Barrett, Haentjens & Co., Hazleton, Pa.—Bulletin 530—Describes the construction and principle of operation of a new suction-line primer for centrifugal pumps developed by this company.

pH Control. W. A. Taylor & Co., 872 Linden Ave., Baltimore, Md.—50-page booklet entitled "Modern pH and Chlorine Control," explaining in detail the meaning and application of pH control and describing the colorimetric sets made by this company.

Refractories. Denver Fire Clay Co., Box 1107, Denver, Colo.—Catalog 145—71-page catalog on firebrick and other refractories, including plastic refractories of various sorts supplied by this company. Gives construction data and includes useful information.

Safety. Willson Products, Inc., Reading, Pa.—8 page booklet containing an article entitled "The Very Least an Employer Should Know About Dust and Fume Diseases." Describes hazards and suggests remedies.

Steam Generation. Babcock & Wilcox Co., 85 Liberty St., New York City—Bulletin G-8—31 pages illustrating, describing and showing installations of this company's Type H Stirling boiler.

Steam Generation. Combustion Engineering Corp., 200 Madison Ave., New York City—8-page catalog describing this company's Type VM bent-tube boiler for use under conditions of limited space.

Tanks. Atlantic Tank Corp., 235 Tonnele Ave., North Bergen, N. J.—36-page catalog describing wood tanks and tank accessories supplied by this company. Gives capacity tables, erection information and other useful data.

Water Treatment. Permutit Co., 440 Fourth Ave., New York City—24-page booklet on the hot lime-soda process of water softening, profusely illustrated with photographs and drawings.

Weld Fittings. Taylor Forge & Pipe Works, Box 485, Chicago, Ill.—Bulletin 32-1—4 pages tabulating dimensional and list-price data on seamless steel fittings for welding.

Welding. Air Reduction Sales Co., Lincoln Bldg., New York City—26-page booklet describing Airco-Davis-Bournonville welding and cutting apparatus and supplies.

NEWS *of the* INDUSTRY

Chemical Center Planned For Chicago

ON Jan. 30, representatives of the Chicago Section of the American Chemical Society and of the Chicago Chemists' Club signed agreements by which both groups will in the future hold their meetings in the Midland Club. In addition, the Chicago Chemists' Club signed a lease for quarters considerably larger than it has previously occupied in the Midland Building, 176 West Adams St., in which the Midland Club is located.

The signing of these agreements marks the termination of negotiations which have been going on for several years to secure enlarged facilities for chemical activities in Chicago. The rapidly growing attendance at meetings of the Chicago Section, which reached 600 at a special petroleum meeting in January, was making imperative a change in meeting place. The new agreements run for five years and are renewable at the end of that time. In addition to providing accommodations for all meetings of the two organizations the plan involves cooperation of the chemical groups and the renting agents of the Midland Building in securing tenants from the chemical industry. If this plan is successful and the building secures a number of tenants who are connected with chemical activities, the name of the building will be changed to indicate its position as a center for chemistry in Chicago.

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Chemical Societies to Hold Joint Meeting

PROF. Bradley Stoughton, chairman of the department of metallurgy, Lehigh University, and president of the Electrochemical Society, will be the speaker at the joint chemical societies' session on Friday, Feb. 19.

This meeting, in charge of the Electrochemical Society, with American Chemical Society, Society of Chemical Industry and Société de Chimie Industrielle cooperating, will be held in the auditorium of the Electrical Institute of the Electrical Association of New York, Grand Central Palace, preceded by supper at the Hotel Shelton.

President Stoughton will take as his subject "Modern Electric Steels," a field of work in which the speaker has been active as consulting engineer for many years. Immediately following the president's paper, there will be an inspection of the electrical and illumination exhibits of the Electrical Institute of the Electrical Association of New York. This tour will afford an opportunity of viewing some of the latest scientific and technical developments of the electrical industry.

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Rubber Symposium for A.S.T.M. Meeting

A SYMPOSIUM on rubber will be the chief feature of the Cleveland regional meeting of the American Society for Testing Materials, which will be held on March 9. Spring group meetings of committees will be held during the week beginning March 7 in the Hotel Cleveland.

The manufacture of rubber products will be the subject of the morning session of the symposium on rubber. The titles of the papers are "The Extent and Diversity of the Rubber Industry," A. W. Carpenter, manager of testing laboratories, B. F. Goodrich Co.; "Crude and Reclaimed Rubber," R. H. Gerke, U. S. Rubber Co.; "Vulcanization," N. A. Shepard, director of chemical research, Firestone Tire and Rubber Co.; "Compounding," a discussion of the fillers, reinforcing agents and softeners used in the compounding of rubber," R. H. Seeds, Goodyear Tire & Rubber Co.; and "Structures of Rubber in Combination With Textiles and Other Materials," C. H. Zieme, technical superintendent, Republic Rubber Co.

At the afternoon session, properties of rubber as an engineering material will be discussed. The papers are: "The Flexing of Rubber Products," E. G. Kimmich, Goodyear Tire & Rubber Co.; "The Use of Rubber for Absorption of Shock and Vibration," R. K. Lee, director of research, Chrysler Corp.; "Some Factors Involved in the Destruction of Rubber Products by Wear," V. A. Cosler, technical superintendent, Hewitt-Gutta Percha Rubber Corp.; "The Chemical Resistance of Rubber as an Engineering Material," H. E. Fritz, manager, and J. R. Hoover, assistant manager, chemical sales division, B. F. Goodrich Co.; "Resistance of Rubber to Water and Gases," R. H. Gerke, U. S. Rubber Co.; "Electrical Characteristics of Rubber Insulation," E. W. Davis and G. J. Crowdes, Simplex Wire & Cable Co.; "Rubber as an Adhesive in Tape, Cements, Frictions and Metal Bonding," J. J. Allen and J. E. Beyer, Firestone Tire & Rubber Co.

Ore Disintegration By Steam Puffing

EXPLOSIVE shattering of minerals as a substitute for crushing is proposed by R. S. Dean and John Gross, of the U. S. Bureau of Mines. Their investigations indicate that if an ore containing diverse mineral substances be saturated with water and then subjected to heating under pressure and released from pressure suddenly it is disintegrated, just as breakfast food is puffed. The shattering is definitely selective according to the relative porosity of the minerals involved. Their investigations therefore indicate the possibility of selective disintegration of materials without grinding.

The work, done thus far on a laboratory experimental basis, indicates that a steam pressure of about 150 lb. is best for the minerals thus far tested. Because no attrition is involved the process apparently will not produce extremely fine particles or slimes. It is believed, therefore, that the material so treated would be in ideal condition for flotation. Calculation on a theoretical energy basis indicates that the cost of fine grinding by normal attrition methods of 5 to 10c. per ton is greater than the probable cost for this new scheme of disintegration. The authors therefore conclude "that the process has better than a fair chance to compete" on the basis of power and energy requirement. Experimental data thus far released are being published by the Bureau of Mines in its Report of Investigations 3118. However, no commercial-scale tests have yet been made.

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Chemical Engineers Plan Washington Meeting

WASHINGTON will be the mecca of chemical engineers the first week in December on the occasion of the annual meeting of American Institute of Chemical Engineers. Definite plans are being made by the Council of the Institute for the convention to be held Dec. 7, 8, and 9. R. S. McBride has been named general chairman of the convention committee and Harrison E. Howe, chairman of the committee on papers. A full program of economic and technical papers with generous opportunity for a visit to outstanding points of historic, scientific, and scenic interest about Washington is being arranged.

New Heat Storage and Transfer Medium

ANNOUNCEMENT of a new heat storage and transfer medium, upon which research has been conducted during the past three years, elicited the greatest amount of interest at the opening sessions of the Industrial Conference on Process Heating held at Case School of Applied Science, Cleveland, Ohio, Feb. 10-12. J. J. Grebe, research engineer for the Dow Chemical Co., in a talk on "New Developments in Indirect Heating," described the new compound and pointed out its extensive potential uses both in the industrial and domestic fields. This product, known as Dow Oil 650, which consists of compounds of the same nature as diphenyl and diphenyloxide, has a boiling point of 650 deg. F., flash point of 356 deg. F., and a viscosity at its boiling point twice that of water at its boiling point.

According to Mr. Grebe, its low viscosity and high stability should make possible its application to standard heat-transfer equipment. Also the new oil allows storage of a considerable amount of heat without high pressure.

That the possibilities of indirect heating have only been touched was emphasized by Mr. Grebe's paper. He asserted that because of the close temperature control possible it was not inconceivable that steel plants would entirely revise their practice and that new industries such as the synthetic resins could profitably use indirect heating, which would yield uniform production with higher quality and at the same time eliminate inventory, thereby reducing fire hazard.

Mr. Grebe also pictured the possibility of introducing heat storage into the home to the extent that all household services could draw on storage provided by the new oil without the need for either control or safety devices. A coil or pipe immersed in the storage oil would convert water into superheated steam which would be available for pressure cooking, roasting, dishwashing, and the like, and even for operating turbine-driven pumps for air-conditioning.

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New Oxygen-Free Copper Developed at Carteret

THROUGH radical alteration in the customary refining and casting methods employed in the production of electrolytic copper, the United States Metals Refining Co., at its Carteret (N. J.) plant has developed a new grade of high-conductivity, oxygen-free copper, culminating several years of intensive research. Through careful control of temperature and speed of casting, and the use of water-cooled molds, the new product contains no included copper oxide. Furthermore, no residual deoxidant remains in the product. The copper is reported to be superior in toughness and ductility, and of excellent cold-working properties. Except in the matter of available shapes, it meets the A.S.T.M. specifications for electrolytic copper in all respects.

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Chemical Section Planned For British Fair

THE British Industries Fair, which was organized to enable world trade buyers to see the whole range of the empire's manufactures, will open on Feb. 22 and continue through March 5. The fair is divided into two sections which run concurrently, one in London and the other in Manchester. No industry may exhibit at both sections. The chemical industry will occupy the annex to the Grand Hall at Olympia, London. Arrangements for the section will be under the auspices of the Association of British Chemical Manufacturers.

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Cornell Expands Lectures In Chemistry

THE Non-Resident Lectureship in Chemistry at Cornell University was established by George Fisher Baker in 1925. Up to the present time lecturers under this plan have been from abroad, each of them remaining at the university for a full term. It is now planned to expand the program by inviting leading chemists of this country to give one or two lectures before the department on the Baker Foundation, and acceptances have been received from the following for the coming university term: Prof. Roger Adams, University of Illinois; Dean S. C. Lind, University of Minnesota; George W. Morey, Geophysical Laboratory, Washington, D. C.; Prof. R. A. Gortner, University of Minnesota; and R. E. Wilson, Standard Oil Co., Chicago, Ill.

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Research in Paper Chemistry At Lawrence College

THE Institute of Paper Chemistry, graduate school affiliated with Lawrence College, has been admitted to the select list of 23 colleges and universities to receive graduate research fellowships in chemistry from E. I. duPont de Nemours & Co. The stipend is for $1,000 and will be awarded to one of the students now enrolled in the institute. The announcement follows closely that of the DuPont company to conduct research in the institute laboratories under the direction of Dr. Samuel Lehner, department head at Wilmington, Del.

The Rohm & Haas Co., manufacturer of synthetic tannin agents, artificial resins and a variety of other products, will conduct experiments to determine their application to the paper industry. Dr. I. C. Sommerville, Edinburgh University, is the first of several company representatives who will study separate phases of the work.

Sugar Institute Faces Federal Charges

WIDESPREAD interest has been aroused in the suit which opened in New York on Feb. 9, in which the government seeks to dissolve the Sugar Institute, alleging it has acted in restraint of trade and in violation of the anti-trust laws. While the suit is of primary interest to the sugar refining companies of this country, practically all of whom are members of the institute, it has a wider significance because of its bearing on the status of other trade associations.

The attorney for the defendants stated that "the present litigation, challenging as it does the rights of existence of the trade associations, is the most important in the past twenty years.

"Practically all of the industries in the United States today are organized on the same general basis as is the Sugar Institute, including 90 per cent of the industries controlling the country's commerce.

"If it be proved that the institute is operating illegally and it should be dissolved, then all others are likewise operating illegally, and the practical consequences of this move on the business of the country will be enormous."

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Aluminum Co. and I. G. Pool Magnesium Alloy Patents

ANNOUNCEMENT has been made of the formation of the Magnesium Development Co. The new company represents a combination of the Aluminum Co. of America and the German I. G. Farben-Industrie A.G., in the use of patent rights for the production of magnesium alloys. Patent rights of the I.G. and the Aluminum company will be taken over by the newly formed organization with the board of directors comprising representatives from both participating companies. Special attention will be devoted to the manufacture of the I. G. alloy, "Elektron," which finds an increasing outlet in the aircraft industry.

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Garvan Heads Textile Research Institute

AT A meeting of the board of directors of the United States Institute for Textile Research, Inc., held at the Chemists' Club, New York City, Jan. 22, Francis P. Garvan, president of the Chemical Foundation, Inc., was elected president of the institute. Mr. Garvan succeeds the late Dr. Samuel W. Stratton, who was the first president of the institute. Other officers elected were: A. F. Bemis, Boston; W. Robert Blum, Lodi, N. J.; H. V. R. Sheel, Passaic, N. J.; Thomas T. Clark, North Billerica, Mass.; and K. T. Lewis, Durham, N. C., vice-presidents; Ernest N. Hood, Salem, Mass., treasurer; Charles H. Clark, Boston, secretary.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

HEARINGS on the Nye trade practice bills have been tentatively scheduled for Feb. 24-25 by the Senate Judiciary Committee. This will give trade association executives an opportunity to tell their story of the complications that have crippled the usefulness of the Federal Trade Commission's conference procedure for the elimination of unfair and uneconomic trade practices. The subject matter of the bills before the committee is not regarded as of immediate importance if eventually legislation can be drafted that will perfect the operation of the trade practice conference plan and possibly of the Commission's functions as a whole. The conviction is growing in Washington that business sooner or later will find a method by which it will be able to obtain from the government competent advice upon the legality of proposed activities. It is becoming equally certain that this will not be accomplished by amending the anti-trust laws. Hope appears to be temporarily dashed by the notice served by the Department of Justice that the bituminous coal industry's plan for the establishment of district selling agencies must be tested in the courts.

Pending consideration by the Senate Committee on Legislation in which an attempt will be made to keep away from discussion of the anti-trust laws, a delegation of trade association executives staged a revival meeting in Washington in the hope that it would furnish the electric impulse needed to stir confidence. The meeting had no program and sentiment was very much mixed. There were some who demanded a temporary injunction to restrain John Lord O'Brian and his cohorts in the Department of Justice from enforcing the anti-trust laws. There were others who sought a legal remedy to protect business against the cut-throat competition born of desperation. Discussion on the competition of government in business also rubbed a sore spot. Some publicity attended the audience given by President Hoover to the delegation, but beyond that it is doubtful whether anything tangible was accomplished by the visit, although it had some dramatic interest.

WHETHER regarded simply as a political dodge or as a policy that this country should adopt to fit the changing conditions of world trade, tariff reciprocity will invite a veto by President Hoover. It is not likely either that Congress will satisfy the demand of special pleaders for protection on oil and copper by using the tax bill as a vehicle for tariff legislation. Already similar treatment has been demanded for pulp, paper, and other products, and it is not difficult for the House Ways and Means Committee to realize where such a procedure would take them. Interior Secretary Wilbur advocates a tariff on oil if coupled with legislation by Congress authorizing state compacts on pro-ration and conservation. The House committee may decide to consider the Tariff Commission's reports on copper and petroleum after reporting the tax bill. This would serve as a test of the provision of the Democratic tariff bill that would deprive the President of his flexible tariff powers by requiring that all reports by the Tariff Commission shall be submitted to Congress. There would, of course, be little necessity for retaining the flexible tariff if the provision of the Democratic bill for tariff making by reciprocal agreement were carried into effect.

Mere repetition of past experience seems to be all that is in prospect with regard to Muscle Shoals. The death of Representative Percy Quin will advance Representative McSwain, South Carolina Democrat, to the chairmanship of the House Committee on Military Affairs. McSwain had been chairman of the subcommittee appointed to draft the bill that probably will call for government operation if the President, within a certain term, is not able to negotiate a lease carrying restrictions, one of which is certain to be the production of a certain minimum of fertilizer for sale at a low price. In this connection the report that the Allied Chemical & Dye Corp. has received a French government contract to supply 25,000 tons of synthetic nitrate is significant. The price is reported to be the same as that on orders from German producers, which was 83 francs per 100 kg., the equivalent of $33.20 per metric ton.

JAPAN is well prepared, from a chemical standpoint, for a long offensive. Large purchases of copper, cotton and other commodities essential for war purposes were made in anticipation of the China campaign. Its own substantial capacity for the production of synthetic ammonia for conversion to nitric acid may be augmented by imports from Chile if necessary. The occupation of Shanghai was no surprise to American business interests represented in China. For several months past branch houses in Shanghai have been asking for instructions from home offices on what plans to pursue.

Insecticide manufacturers are studying the adoption of means providing a more positive warning of the poisonous character of their products as an alternative to legislation that would require discoloration of poisons which resemble commonly used foodstuffs. The origin of several bills introduced in Congress is the accidental substitution of calcium arsenate for baking powder and flour. This has occurred in the South, where arsenate of lime is widely used in combating boll-weevil infestation. Investigation has proved that the addition of a coloring agent to white insecticide is not feasible and the manufacturers now are turning their attention to the labels. Discoloration of poisons is not regarded as effective, according to Warren Watson, secretary of the Manufacturing Chemists' Association, because many poisons have a natural and distinctive color and the use of color in foodstuffs is rapidly increasing. Such staples as sugar and bread now are available in tints of pink, blue and green. The addition of color would interfere with the utility of many poisons used in industry and also would be objectionable in medicinals of a toxic character.

CALENDAR

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, spring meeting, Schenectady and Corning, N. Y., June.

AMERICAN CHEMICAL SOCIETY, 83d meeting, New Orleans, March 28-April 1.

ELECTROCHEMICAL SOCIETY, spring meeting, Baltimore, April 21-23.

INTERNATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY, Madrid, Spain, April 3-10.

RUBBER DIVISION, American Chemical Society, spring meeting, Detroit, Feb. 25-26.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, New York City, Feb. 15-18.

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Flaxseed and Casein Costs Under Investigation

THE Tariff Commission has approved plans for work in Argentina in connection with the costs of production of flaxseed and casein. The flaxseed investigation was ordered in response to an application from the Association Nacional de Agricultura, of Argentina, and the casein investigation was ordered in compliance with a resolution passed by the U. S. Senate.

The commission also announces that applications recently received from the Monite Waterproof Glue Co., of Minneapolis, Minn., and the Centro de la Industria Lechera, of Buenos Aires, requesting decreases in the rate of duty on casein, have been merged with the pending investigation on that subject.

Washington, Baltimore Entertain American Ceramic Society

Ceramists "See Washington," Visit Bureau of Standards, Make Baltimore Inspection Trips

FOUR DAYS in Washington and an additional day at Baltimore were given over to the 34th annual meeting of the American Ceramic Society, which, together with the National Brick Manufacturers' Research Foundation, met during the period from Feb. 8 to 12, inclusive. In spite of very unfavorable business conditions, registration was unexpectedly large, with about 700 ceramists attending, as compared with a registration close to 1,500 at the Cleveland meeting in 1931. Presentation of papers began with the meetings of the seven divisions of the society on Feb. 9, continuing through the 11th. Lincoln's Birthday saw the society in Baltimore, where the entire group visited the plant of the Locke Insulator Corp., later splitting into divisions for visits to plants more specifically in line with the interests of the individuals.

Election of officers was announced at the President's Dance on Wednesday night. The new president of the society is Emerson P. Poste, Chattanooga Stamping & Enameling Co., Chattanooga, Tenn. W. Keith McAfee, Universal Sanitary Mfg. Co., was elected vice-president. H. B. Henderson and Ross C. Purdy were reelected as treasurer and general secretary, respectively. It was announced that, continuing the policy initiated in 1931, the society had elected five men to the degree of Fellow, to join the company of more than 150 already so honored.

IN ADDITION to sight-seeing trips to points of interest in and about Washington, the society was given an opportunity to visit the silicate and clay-products division of the U. S. Bureau of Standards. Chief among the points of interest were those sections engaged in the manufacture of optical glass and in the construction of glass pots. Research initiated during the War has culminated in a small manufacturing section at the Bureau which has for several years supplied the greater part of the optical glass for the Army and Navy.

Expansion studies constituted a principal focus of interest in several of the sections of the Bureau. Demonstrations included interferometer and gage measurements of the thermal expansion of glasses, refractories, and enamels. A demonstration of petrographic sections under the projecting microscope illustrated graphically the composition of several materials of considerable ceramic interest. Most spectacular was a demonstration of the Bureau's new 10,000,000-lb. testing machine, the largest in the world. For the benefit of the society, it was used to crush a brick wall 6 ft. in height, failure occurring with almost explosive violence.

At the general meeting Tuesday evening, retiring president E. V. Eskesen paid tribute to Gen. Orton, past president of the society and long active in its affairs, who is reported to be in precarious health. As second speaker of the evening, Frederick Willson, of Willson Products, Inc., described at some length the action of industrial dusts on human lung tissue. Especially if these are of silica, or a silicate, lung fibrosis and a predisposition to pneumonia and tuberculosis are likely to ensue. Silica is more dangerous than silicates. Protection demands efficient exhaust systems and frequently personal protection in the form of respirators.

Richard F. Bach, of the Metropolitan Museum of Art, New York City, delivered a pointed appeal for what he called "quality production." Granting the technical excellence of many products, ceramic and otherwise, he nevertheless deplored the decline of the craftsman era. The machine, he said, can produce a product good to look at only when it is "fed" good designs.

At the various division meetings, more than one hundred papers were given, several of which were in the nature of symposiums. From the standpoint of chemical engineers, the most interesting of the work reported on enamels was that of Messrs. Harrison and Sweo, U. S. Bureau of Standards. Working on the coefficients of expansion of vitreous enamels, these investigators found that composition variations do not give the straight-line expansion variations that have been supposed to exist.

A number of important papers were given before the glass division. Reporting observations on devitrified glass, Messrs. Tool, Insley and Saunders, U. S. Bureau of Standards, mentioned the probability of a new form of silica. G. W. Morey, Geophysical Laboratory, Washington, reported on the effect of boric oxide additions on the devitrification of soda-lime-silica glasses. Small additions lower the temperature above which devitrification cannot be obtained. L. H. Adams, Geophysical Laboratory, reviewed the principles underlying the annealing of glass and emphasized the need for differentiation between phenomena which do and which do not involve the internal composition of the glass. Messrs. Tool and Tilton, Bureau of Standards, reported on the effect of annealing on the refractivity of optical glass.

Control testing in the manufacture of firebrick occupied a considerable part of the attention of the refractories division. The 11 papers in this group covered general considerations, theory and methods of sampling, laboratory, grinding and sieving tests, control tests in the addition of water, in pressing, drying and firing. An interesting point in this connection was the paper of J. O. Everhart, Ohio State University, who told of the use of a recording ammeter in controlling moisture at the pug mill. Papers on the reproduction of service conditions in the laboratory, by F. H. Norton, M.I.T., and on the A.S.T.M. viewpoint in the control of fired brick, by L. J. Trostel, General Refractories Co., completed the symposium.

Messrs. Heindl, Pendergast and Mong, of the Bureau of Standards, reported interesting results of an investigation into the effect of firing temperatures on the properties of several kaolins. Other papers, stressing the engineering angle, included those of E. J. Bognar, Corundite Refractories, Inc., who dwelt at length on the flexibility of the gas-fired tunnel kiln. J. A. Fellows, Babcock & Wilcox Fellow at M.I.T., described the derivation of suitable dome shapes for circular kilns. S. S. Cole, the Koppers Co. Laboratories, investigated the high-temperature strength of silica brick. A definite relationship was found to exist between the strength at room temperature and at the elevated temperature. Messrs. Cunliffe and Clem, University of Washington, discussed the refractory requirements of black-ash furnaces in the pulp and paper industry; and F. W. Preston, Standard Mfg. Co., the spalling of refractories.

SUBJECTS taken up by the structural clay-products division ranged from consideration of the effect of chromium plating machine parts subject to the abrasive action of clay, to the use of natural gas in kiln firing. R. T. Stull, Bureau of Standards, told of work on the resistance of construction materials to the abrasive action of clay. Other papers concerned raw materials for heavy clay products, progress in brickwork construction, and improved technique in drying, grinding, and firing.

The terra cotta division took up tests, fire-cracking, shrinkage, and the moisture expansion of glasses. Crazing, and studies of glazes, were considered. In the white-wares division interest was about equally divided between technical and plant problems. C. F. Greene, of the AC Spark Plug Co., discussed the use of butane as a kiln fuel. Messrs. Harrop and Hartford explained the application of small tunnel kilns in ceramic industries. A symposium on plant problems concerned itself with every phase of white-ware manufacture, from raw materials to the finished product. Sampling and raw materials had their share of interest in other papers. Messrs. Carter and King, Ohio State University, reported on the effect of using sodium aluminate for the pH control of casting slips. The result of its use is said to be the minimizing of certain troubles ordinarily encountered.

International Agreements Formed By French Industries

Dyes, Nitrates, and Ceramics Affected By Recent Compacts

From Our Paris Correspondent

THE MOST important recent developments affecting French industries have been connected with the formation of conventions or agreements with other European countries. Prominent among these was an arrangement made between the French and Rumanian governments whereby Rumania is to supply 400,000 tons of petroleum and petroleum products yearly to France. Oil refining in France has made considerable progress since the law regulating imports of petroleum became effective, and the arrangement made with Rumania is expected to give greater stimulus to the refining industry. Rumania will benefit not only by the outlet thus afforded for its oil but also may be placed in a favorable position to develop an export business in corn with France. Incidentally, the quantity of petroleum specified in the present agreement is a minimum figure which may be considerably increased.

The French metal industry presents another example of stabilization through a working agreement adopted by producers. On Dec. 30, all the steel manufacturers in France ratified a production schedule with total output controlled and production allocated among the different companies. As a result of this step, competitive selling will be done away with and it will be possible to establish a central selling organization. Moreover, it is anticipated that the agreement will be extended so as to include all the metal fabricating industries.

SYNTHETIC nitrates formed the basis for a compact drawn up between France and Germany. France is now producing sulphate of ammonia in quantities sufficient to take care of its agricultural needs. Home production of calcium cyanamide also is increasing; the Société des Produits Azotes, for instance, has installed new ovens with total electric power of 13,000 kw. at its works at Bellegarde and Lannemazan with the object of developing this production. French production of synthetic nitrates, on the other hand, has made but little progress. A new plant to use the Bamag-Meguin process is being equipped at the National Nitrogen Works at Toulouse, but will not be in operation for a long time. In the meantime, French agriculture requires 300,000 tons of nitrate yearly. As satisfactory prices could not be agreed on with sellers of the Chilean product, a contract was made on Dec. 27 between the Comptoir Français de l'Azote and the Stickstoff-Syndikat whereby German producers are to supply 150,000 tons of synthetic nitrate of soda to France in the present year.

THE contract further provides for imports of 150,000 tons of German synthetic nitrate of soda in succeeding years until French production becomes large enough to cover consuming requirements.

As a result of this agreement there has been a decline in prices for all nitrates and, while this is of benefit to the agricultural industry, it is not so favorable to the development of the French nitrate industry. It is probable that a part of the sum thus saved for consumers will be paid to producers to compensate for the lower market price.

Agreements of lesser importance were signed last November between the French, German and Czechoslovakian chinaware manufacturers with the object of regulating and adjusting prices in that line; these understandings were dictated by the fact that the French china manufacturers had to fight against keen competition from importers.

An agreement of similar nature is now about to be concluded in the glassware industry, which also is experiencing difficulties owing to foreign and especially Czechoslovakian competition; so much so that about 40 glassware manufacturers were compelled to stop work. It should be mentioned, however, that some of the works of over a century's standing require reorganization and the introduction of more up-to-date methods.

As far as coloring matters are concerned, an understanding has been reached between French, German, Swiss and British producers with the object of regulating prices and imports. French production of dyes, as a matter of fact, has not been severely influenced by the crisis which the textile industry is undergoing. Production amounted to some 15,959 tons in 1930, against 16,430 tons in 1929.

From a technical and chemical point of view there is but little to mention, as no new manufacture is being undertaken. All the efforts of manufacturers tend rather to lowering working costs, either by rationalizing or by modernizing their plants.

The firm of "Société Progil," of Lyons, which owns several works, has recently been reorganized; that of Société Kétol, which proposed to manufacture ketonic solvents from sawdust, failed in its financial arrangements as did the firm of Société l'Iode et l'Algine, which proposed to extract iodine and alginic acid or alginates from seaweed and plants after patented processes. The preparation of synthetic camphor by Société Alsacienne de Produits Chimiques also has proved unsuccessful. On the other hand, synthetic industries using coke-oven gases are developing in a way that is worth mentioning. Compagnie de Béthune, for instance, in 1930-1931, produced 12,985 hectoliters of synthetic ethylic acid by means of ethylene extracted from coke gases besides 14,000 hectoliters of synthetic methanol, 80 tons of sulphuric ether, and nearly 800 tons of formol.

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Chemicals Used in Canadian Pulp and Paper Trade

IN A report from Trade Commissioner Avery F. Peterson, Toronto, Canada, it is stated that provincial consumption statistics for individual items used in the manufacture of wood pulp and in the manufacture of paper are not available. However, totals of materials used are available by provincial divisions and, on a basis of total materials used in Ontario, it is possible to estimate provincial consumption of specific chemicals. Following are reported figures for the entire Canadian industry:

Chemicals Used in Manufacture of Wood Pulp

	Tons	Value
Sulphur	154,889	$3,689,617
Limestone	169,020	529,879
Lime	81,407	812,822
Soda ash	1,545	60,796
Liquid chlorine	14,192	925,949
Other bleach	6,604	147,473
Salt cake	33,119	676,597
Common salt	8,960	91,730
All other chemicals	681	32,556
Pulp stones	No. 887	576,959
All other materials	.....	1,917,312
Total	.....	$9,461,690

Chemicals Used in the Manufacture of Paper

	Tons	Value
Soda ash	1,993	$70,864
Alum	21,951	630,410
Clay	13,024	218,423
Size	7,028	516,928
Dyes and colors	.....	329,362
Other materials, including asphalt, rosin, caustic soda, talc, starch, sulphate of iron, lime, liquid, chlorine, bleaching powder and fillers	.....	4,384,563
Total	.....	$6,150,550

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Virginia Smelting Retains Chemical Branches

Recently the Virginia Smelting Co. joined with the National Lead Co. in the formation of a new corporation, the Virginia Lead Smelting Corp. The new company will take over and conduct the lead business heretofore conducted by the lead department of the Virginia Smelting Co. Reports have been current to the effect the chemical and smelting activities of the Virginia Smelting Co. were involved in the new arrangement. This is not so, however, as the National Lead Co. has no interest in the chemical and other activities conducted at West Norfolk.

Agreements Steady Chemical Prices In German Markets

Measures Taken to Overcome Difficulties in Foreign Trade

From Our Berlin Correspondent

IT GOES without saying that the industrial situation grows progressively worse and that Germany's participation in world production has sunk from 12 per cent in 1928 to 9 per cent in 1931. The chemical market was only slightly affected by the critical price development in general, mainly because agreements kept the structure upright. Only the last emergency decree caused a reduction of 10 per cent.

Foreign trade conditions are becoming increasingly difficult, as they are in many other countries. Among the measures being taken to combat this situation are the negotiations aiming at a standard motor fuel in Germany, both to stop fluctuations in the market and to consume a maximum of domestically manufactured products. Experiments indicate that the most suitable knockless motor fuel would consist of gasoline, 70; benzol, 10; ethyl alcohol, 10; and methyl alcohol, 10 per cent. The latter is merely intended to reduce the cost of alcohol admixtures, since methyl costs about half as much as ethyl alcohol. In any case, the last three constituents would all be of domestic origin, the continued production of which would be favorable to chemical industry as a whole, especially the large nitrogen plant. Of a national annual consumption of 1,500,000 tons of motor fuel, 150,000 tons of benzol, 150,000 tons of alcohol and 150,000 tons of methanol would come from domestic sources. Furthermore, about 250,000 tons of gasoline can already be produced in Germany and the capacity of the I. G.'s synthetic gasoline plant can easily be brought up to 350,000 tons. This would account for well over half the present motor fuel consumption. A further saving of about half of the 50,000 filling stations and the elimination of wasteful competition, with its expensive advertising, present the possibility of attaining a low price for pure gasoline in spite of the addition of the expensive alcohol. The project has many obstacles, such as the reduction in customs duties and the difficulties of motor manufacturers trying to compete in foreign markets with specialized motors adjusted to this fuel.

THE construction of the refinery at Misburg, undertaken jointly by MacKee & Co., Cleveland, and the Preussische Bergwerke und Hütten, A.G., the Gewerkschaft Elverath, and the Wintershall A.G., has been so advanced by the favorable weather that operations probably will be undertaken in February. The plant is located along the Mittellandkanal, the large storage facilities already being used to hold the output from the seven wells. As soon as refining operations begin, it will no longer be necessary to throttle the drillings. The Crack Oil Co. has been founded in Berlin and intends to lease a large section of the oil concessions in Hannover in order to erect a refinery there for the Carburol cracking process, which has been satisfactorily used by the Borsig G.m.b.H. in numerous plants; for example, in Peckelbronn (Alsace).

An attempt has already been made to use coal-tar oils for diesel motors, and recently technical improvements and lower costs have brought up the question again. The construction of the "Ruston" motor is said to be a solution to the problem. It is being built in sizes from 17 hp. upward and many have been running satisfactorily for some time in Germany. A necessary feature of satisfactory operations, in addition to suitable material of construction, is the proportioning injector which feeds about 96 per cent of tar oil and 4 per cent of gas oil as required under full load. In operation there is not only a marked fuel economy but also a satisfactory maintenance of operation in comparison with gas oil. According to Leymann and Weber, the explosion resultant on compression of tar oils with compressed air is due not only to spontaneous combustion, by ignition through the pressure, but also to the presence of pyrophorous iron sulphide, which glows at 48 to 50 deg. C. in contact with air. In the case of tar oils, which do not favor formation of iron sulphide, explosions are also explained by the presence of moisture in compressed air striking the hot chamber walls. This is combated by the use of nitrogen or cleaned combustion gases instead of air and by the use of chromium or aluminum plating of the walls.

FORMATION of a joint company for the production and marketing of magnesium metal, under the name of I. G. Farben-Aluminum Co. of America, has already been publicly reported. The American production of magnesium has hitherto been smaller than the German, which commands more favorable raw material sources. A stainless, austenitic metal for steam turbines is being produced by Krupp under the designation of WF-100 steel, containing about 15 per cent chromium, 1.3 per cent of nickel, and 2 per cent tungsten. This metal is very resistant to pitting and corrosion under kinetic strain, partly because of its high elastic limit and tensile strength. New discoveries of gold near Kassel have naturally excited great interest. Engineers of the Preussische Bergwerke und Hütten A. G. have since made promising experiments for the extraction of ores at Korbach in Waldack. Further appearance of gold has been reliably reported at Allendorf near a mineral springs, which authorities consider promising.

THE comparatively rare metal gallium has now become technically available. Even up to 1931 its price was $44 a gram, but the Ver. Chem. Fab. Leopoldshall, which also produces rhenium, is now offering it at about $2.50. One of its uses, as filler for quartz thermometers from 50 to 1,000 deg. C., has already passed successful trial at the National Physical-Technical Institute. The metal melts at 30 deg. C. and boils at 2,000 deg. C. Other uses in consideration are in optical mirrors, control and signal devices, and dental amalgam.

New colors for the painting of glass, very intense and luminous, have been produced by Prof. Wilhelm Ostwald in connection with his work on colors. The transparency of colors has always found an obstacle in the physical opacity of white pigments. Ostwald overcomes this by the use of a colloidal transparent carrier, gelatine. These so-called "Kollon" colors, which liquefy at 50 deg. C., are applied on clean glass; the colors remain liquid about 10 minutes, sufficient time for their application and distribution.

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Sales of Lime Declined In 1931

SALES of lime in 1931 by producers in the United States amounted to 2,710,000 short tons, valued at $18,506,000, according to preliminary figures furnished by lime manufacturers to the U. S. Bureau of Mines. This is a decrease of 20 per cent in quantity and 28 per cent in value as compared with sales of 3,387,880 tons, valued at $25,616,486, in 1930, and follows a decrease of 21 per cent in quantity and 23 per cent in value in 1930 as compared with 1929.

Sales of lime in 1931 for construction are estimated at 970,000 tons, compared with 1,204,614 tons in 1930, a decrease of 19 per cent. This followed a decrease of 27 per cent in 1930 from the 1929 production. Sales of lime for chemical uses are estimated at 1,460,000 tons, a decrease of 21 per cent from 1930 (1,840,155 tons). In 1930 there was a decrease of 20 per cent from the 1929 sales. The sales of lime for agricultural use are estimated at 280,000 tons, a decrease of 18 per cent in 1931 from 1930 (343,111 tons) and following an increase of 1 per cent in 1930 from the 1929 figures. All the states producing lime except two, Florida and Massachusetts, showed decreases from the 1930 production ranging from 5 to 75 per cent in quantity and 8 to 60 per cent in value. Ohio maintained its place as the largest producing state.

MEN
IN CHEMICAL ENGINEERING

CHARLES H. MACDOWELL resigned as president of the Armour Fertilizer Works and vice-president of Armour & Co. after 45 years of service with the company. He joined it in 1887 and six years later began work on the foundation of the Armour Fertilizer Works. While expanding to its present size, he also became interested in other chemical processes, some based on meat packing wastes and others on American natural resources such as potash. During the War his services were enlisted in a number of important national functions, here and abroad.

A. B. LAMB, professor of chemistry at Harvard University, has been elected president of the American Chemical Society for 1933, to follow L. V. Redman of the Bakelite Corp., who was recently installed as president for the current year.

STANLEY GILL has opened offices in Houston, Tex., for a consulting practice in chemical and petroleum engineering, specializing in corrosion.

B. L. HATHORNE and HENRY GREEN, formerly in charge of the technical service laboratory of the Tubize Chatillon Corp., have formed a consulting practice on rayon problems. Mr. Green had also been with the New Jersey Zinc Co. for 12 years and Mr. Hathorne was long active in textile and rayon dyeing.

W. L. BADGER, professor of chemical engineering of the University of Michigan, has withdrawn from the Whiting Corp., where he did consulting work for the Whiting-Swenson Co., now dissolved. Prof. Badger will continue his private consulting practice.

JAMES BRYANT CONANT, chairman of the division of chemistry at Harvard University, was recipient of the Chandler Medal of Columbia University on Feb. 5, and will receive the Nichols Medal on March 11, in accordance with its recent award.

CHARLES H. HERTY has been named to receive the annual medal of the American Institute of Chemists for 1932 in consideration of his many years' work for the advancement of domestic chemistry and chemical industry. The presentation will be made in New York City in May.

P. H. MURPHY has accepted the position of general administrator to the sugar cane industries of G. Melendez, in El Salvador. His problems, in addition to normal sugar technology, will be the utilization of excess low-grade sugars.

J. G. DAVIDSON, who has been director of chemical sales for the Carbide & Carbon Chemicals Corp. since 1923, has been elected a vice-president of the corporation. Dr. Davidson received his education at the University of Southern California, and returned East to work at an industrial fellowship in the Mellon Institute before joining his present firm.

CHARLES H. PROCTOR, for almost 20 years electroplating specialist of the Roessler & Hasslacher Chemical Co., retired from active service at the beginning of this year, but will continue in a consulting capacity.

J. B. F. HERRESHOFF

ALCAN HIRSCH, consulting chemical engineer, of New York City, has been appointed in a consulting capacity to the U.S.S.R. National Planning Bureau and the All-Union Chemical Industries, with headquarters in Moscow. He will henceforth spend most of his time in Russia.

H. J. FRENCH, who has been associated with the International Nickel Co.'s research laboratory in Bayonne, N. J., has been transferred to the development and research department in New York City.

JOHN E. SANFORD, executive vice-president of the Armour Fertilizer Works since 1922, has been elected president to succeed Charles H. MacDowell, who retired recently. Mr. Sanford had been with the Tennessee Chemical Co. for several years before it was bought by Armour in 1909, and then continued work with the new owner.

C. F. GLICKSMAN has joined the Glyco Products Co., Inc., Brooklyn, N. Y., for work on emulsions.

P. VAL KOLB, since 1924 active in the Provident Chemical Works, St. Louis, has been elected president of that company, a subsidiary of the Swann Corp.

LEON V. QUIGLEY, formerly technical editor for the Bakelite Corp. and instructor in chemical engineering at Worcester Polytechnic Institute, has opened an office in New York City as public relations counsel, specializing on the chemical industry.

OBITUARY

W. E. CALLAHAN, plant engineer of the American Cyanamid Company, died on Jan. 24, as a result of a paralytic stroke. He had been with the American Cyanamid Co. over a period of 14 years, except for two years spent as plant manager of the Sharples Solvent Co., Charleston, W. Va.

ANDREW J. STACEY, vice-president and director of Stacey Bros. Gas Construction Co., died on Jan. 18 at his home near Cincinnati at the age of 73.

LEROY H. MINTON, consulting ceramic engineer and former director of the General Ceramics Co., died at his home in Metuchen, N. J., on Dec. 15, at the age of 49. A native of Covington, Ohio, he came East in 1906 as ceramic chemist, and in 1914 joined the General Ceramics Co. at Metuchen. He was appointed general superintendent over all plants of the company in 1921. After his resignation, in 1928, he conducted a private consulting practice.

ALAN F. HILTON, metallurgist of the Farrell-Birmingham Co., died in New Haven, Conn., on Jan. 25, after a sudden illness. He was 38 years old.

J. B. F. HERRESHOFF, outstanding chemical and metallurgical engineer, died at his home in Atlanta, Ga., on Jan. 30 at the age of 81. A native of Rhode Island and a graduate in 1870 from Brown University, he soon entered chemical processing and later became first recipient of the Perkin Medal. For a long period he was professor at Brown University and among his industrial connections was his vice-presidency of the Nichols Copper Co. The furnace bearing his name is one of the foremost and most widely applied of his achievements.

GILBERT ALBION BRAGG, general manager of the Koppers Research Corp., died on Feb. 2, at his home in Pittsburgh, following an attack of influenza. Mr. Bragg was born at St. Joseph, Mo., in 1891, was educated at the University of Kansas, and there entered professional work on an industrial fellowship, later transferred to Mellon Institute. In 1921 he entered the Metals Recovery Co. at Salt Lake City, as field engineer, and after four years of service in this position, he joined the Koppers Co. at its Seaboard plant, to engage in process development. A year later, in 1926, he was made head of the chemical engineering division of the company in Pittsburgh, and in 1930 was appointed general manager of the Koppers Research Corp.

Distribution Channels for Products Of Process Industries

ADDITIONAL reports on the channels through which the process industries market their products have been made available by the U. S. Census of Distribution. In the January issue of *Chem. & Met.* distribution channels for a number of industries were summarized. The following summary of the branches enumerated, for which information is now available, practically rounds out the presentation for the entire process industries.

A striking feature clearly demonstrated by the returns from this first Census of Distribution is the large extent to which industrial goods are marketed direct to consuming industries. Direct sales naturally were increased by the trend in recent years of merging different companies as the finished products of one branch became the raw materials for other branches. As evidence of this it will be noted that of the total sales shown in the accompanying table, 29.1 per cent was made to owned branches. Sales to retail-owned branches were relatively small in all cases with the exception of carbon paper and inked ribbons and grease and tallow.

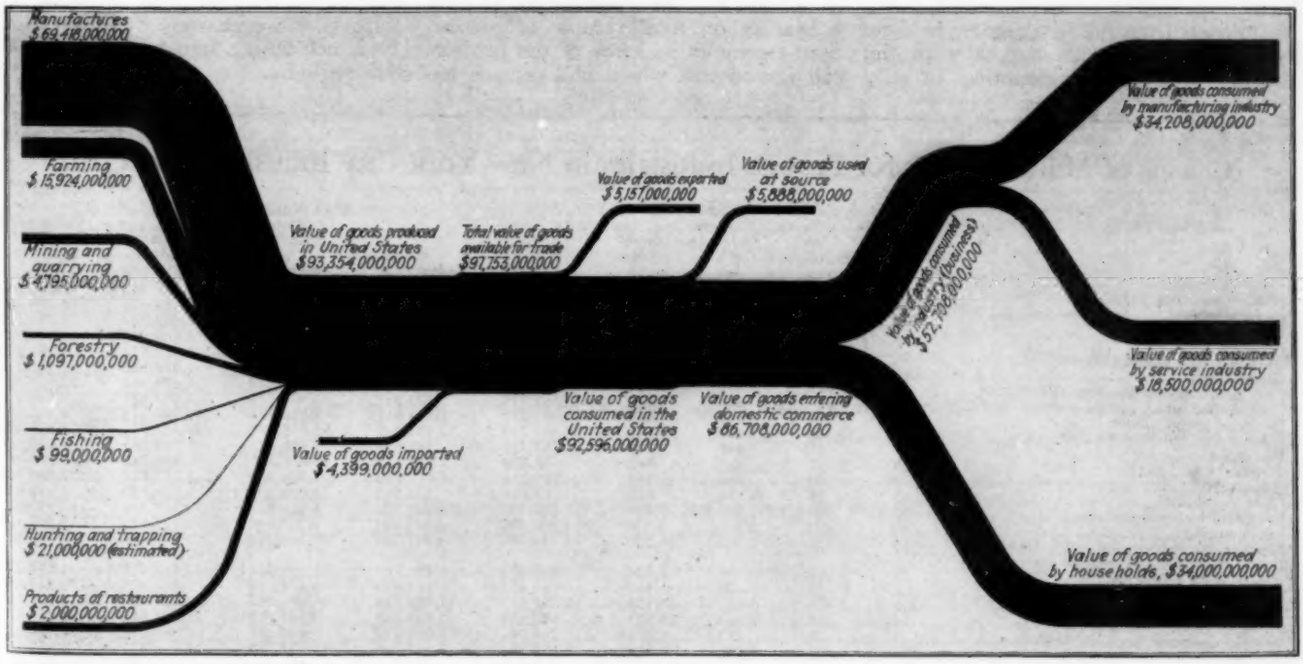
In some cases the distribution figures reveal that producers found it desirable to turn their output over to outside selling agencies rather than set up their own sales organizations. For instance, in the lime industry 13 producing companies sold their entire production through outside agencies. Other producers of lime also made use of selling agents, brokers, and commission houses, yet the total of such sales, including those of the 13 companies before referred to, amounted to only about 8.6 per cent of the total sales, which proves the preponderance of direct sales in that industry.

Up to about ten years ago, brokers played an important part in the distribution of chemicals; later there has been a decided trend toward direct contact between producer and consumer. In the present distribution compilation, the figures bring to light that of sales of $715,176,000, but $44,765,000, or less than 6 per cent, was sold through the aid of outside agencies, despite the fact that 27 producers disposed of their entire output in that manner.

From the information now at hand it is not possible to give a breakdown for the distribution of the individual commodities of greatest interest to chemical engineering enterprises. It is evident, however, that the industrial market is of extreme importance.

Sales by manufacturers of:	Total Value of Sales (Millions)	Sales to Owned Branches — Wholesale — Per Cent	Sales to Owned Branches — Wholesale — Value Millions	Sales to Owned Branches — Retail — Per Cent	Sales to Owned Branches — Retail — Value Millions	Sales to Dealers — Wholesale — Per Cent	Sales to Dealers — Wholesale — Value Millions	Sales to Dealers — Retail — Per Cent	Sales to Dealers — Retail — Value Millions	Sales to Consumers — Industrial — Per Cent	Sales to Consumers — Industrial — Value Millions	Sales to Consumers — Household — Per Cent	Sales to Consumers — Household — Value Millions
Asbestos products	$101.5	27.8	$28.2	....	....	38.4	$39.0	....	....	33.8	$34.3	....	....
Bluing	1.4	....	....	....	....	95.8	1.3	4.2	0.1	....	....	....	....
Coke	197.7	2.4	4.8	....	....	41.1	81.3	11.4	22.5	42.7	84.5	2.4	4.6
Compressed and liquefied gases	51.8	17.1†	8.9†	....	....	....	....	....	....	82.9	42.9	....	....
Cork products	22.1	73.2†	16.2†	....	....	....	....	....	....	26.8	5.9	....	....
Cottonseed products	267.8	4.5	12.1	0.7	1.7	45.1	120.8	5.9	15.8	43.8	117.4	....	....
Glass	287.2	....	....	0.5	1.4	52.9*	151.8*	7.9	22.7	38.7	111.3	....	....
Glue and gelatin	33.9	....	....	....	....	42.7*	14.4*	1.7	0.6	55.6	18.9	....	....
Grease (except lubricating) and tallow	59.8	2.7	1.6	20.8	12.4	5.8	3.5	....	....	70.7	42.3	....	....
Other oils	45.2	....	....	....	....	22.7*	10.2*	0.3	0.2	77.0	34.8	....	....
Lubricants not made in petroleum refineries	72.3	31.9	23.0	....	....	26.7	19.3	13.8	10.0	26.7	19.3	0.9	0.7
Other rubber goods	231.2	15.0	34.7	0.4	0.8	38.7	89.6	7.2	16.6	38.2	88.3	0.5	1.2
Perfumes, cosmetics, and toilet preparations	193.4	2.6	5.1	1.4	2.7	44.9	86.9	43.1	83.4	1.2	2.2	6.8	13.1
Pulp	52.1	....	....	....	....	0.6	0.3	....	....	99.4	51.8	....	....
Lime	35.8	9.2	3.3	....	....	27.9	10.0	25.3	9.0	37.6	13.5	....	....
Process industries reported in January issue, *Chem. & Met.*	9,786.0	30.1	2,943.7	2.4	236.4	30.8	3,003.6	8.6	842.8	26.8	2,626.0	1.3	133.5
Total all process industries	11,439.2	26.9	3,081.6	2.2	255.4	31.8	3,632.0	8.9	1,023.7	28.9	3,293.4	1.3	153.1

* Includes some goods sold through owned wholesale branches. † Includes some goods sold through non-owned wholesalers.


Manufactures $69,418,000,000
Farming $15,924,000,000
Mining and quarrying $4,795,000,000
Forestry $1,097,000,000
Fishing $99,000,000
Hunting and trapping $21,000,000 (estimated)
Products of restaurants $2,000,000,000
Value of goods produced in United States $93,354,000,000
Total value of goods available for trade $97,753,000,000
Value of goods exported $5,157,000,000
Value of goods used at source $5,888,000,000
Value of goods imported $4,399,000,000
Value of goods consumed in the United States $92,596,000,000
Value of goods entering domestic commerce $86,708,000,000
Value of goods consumed by industry (business) $52,708,000,000
Value of goods consumed by manufacturing industry $34,208,000,000
Value of goods consumed by service industry $16,500,000,000
Value of goods consumed by households, $34,000,000,000

Taking all the commodities produced in the United States in a typical recent year, a flow sheet of industrial goods has been prepared. The accompanying chart shows for goods of all classes that the consumption in manufacturing industry of such goods amounts to the impressive total of $34,000,000,000.

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Chemical Output Declined Slightly Last Month

Many Groups Maintained Same Rate as in December

BASED on consumption of electrical energy, manufacturers of chemicals operated at a slightly lower rate during January than in the preceding month. The index number for chemical production in January was 123.9, which represents a drop of about 2 per cent from the rate of activities in December. Many branches of the industry reported practically no change in their production schedules for the period.

Production of alkalis was reported to be higher in January than in the preceding month. Some producers of solvents also increased production in January. Mineral acids appear to have been subject to a slight reduction in the output for last month and the same holds true for some of the products which depend on mineral bases.

Reports from the fertilizer trade show up unfavorably with tag sales in the 16 tag sale states amounting to only 48 per cent of the total reported for January, 1931.

Encouraging reports from some of the large consuming industries hold out promise for a freer distribution of chemicals in the near future. The automotive, tire, textile, and plate glass industries may be cited as examples of lines in which increasing amounts of chemicals are expected to be absorbed.

Restrictions placed on production of petroleum is checking refinery operations and oil refining in the first quarter of this year undoubtedly will require less chemicals than was the case in the corresponding period of last year.

Commercial production of new chemical products already has been announced this year and activities of newly formed companies also may be expected to have a bearing on total volume of production, especially as some of the projects call for outputs which will replace imported goods. Hence this production will not merely replace other domestic products.

UNLESS the situation in the Far East develops an export demand for chemical products, there is not much indication that foreign trade will improve over that of last year. The Chemical Division reports that foreign trade in chemicals and allied products in 1931 not only reflected world-wide conditions in industry in general but also showed the effects of changes in the world's chemical industry and the lessening dependence of the United States upon foreign sources of supply for former essential commodities. For the first time since war years, the United States recorded a favorable chemical trade balance. Exports valued at $130,645,000 were $12,000,000 greater than imports. The trade both ways showed marked reductions—exports 24 per cent less than in 1930 and imports off 31 per cent.

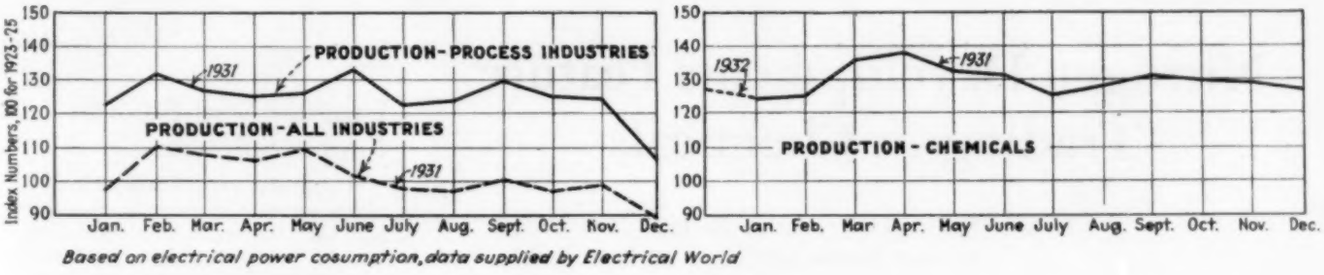
Exports exceeded the low points reached in 1921 and 1922, but, nevertheless, were smaller than in all recent years, the only other low year of the past decade having been in 1924, when exports were valued at $137,282,000. Imports, however, were the lowest since 1912, not taking into consideration the war period.

Census of Manufactures for Process Industries in New York City Industrial Area, 1929

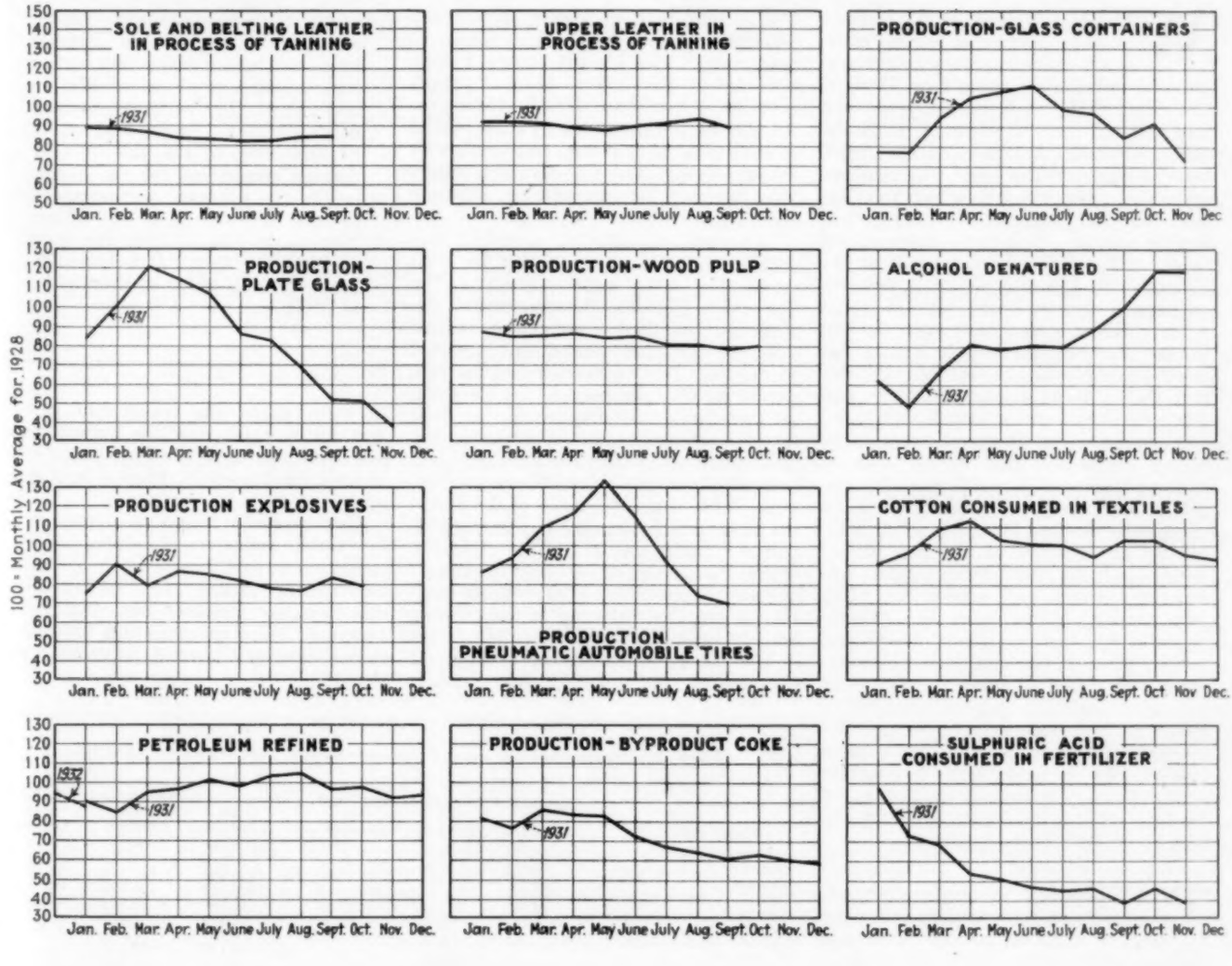
	No. of Establishments	Salaried Officers and Employees	Wage Earners, Average for Year	Horsepower	Salaries	Wages	Cost Materials, Containers, Fuel and Power	Value of Products	Value Added by Manufacture
Artificial leather	7	139	583	5,633	$503,989	$1,004,522	$8,173,178	$10,875,556	$2,702,378
Baking powders, yeast, etc.	11	155	832	14,677	570,184	1,260,820	5,409,832	10,476,286	5,066,454
Beverages	355	959	3,462	28,319	2,850,279	5,969,228	10,945,844	31,545,253	20,599,409
Blackings, stains, etc.	19	119	307	644	403,388	372,325	1,716,420	4,447,947	2,731,527
Candles	7	32	215	207	168,394	282,346	882,907	1,844,612	961,705
Carbon paper, inked ribbons	16	118	310	1,643	441,107	457,808	1,846,286	4,052,012	2,205,726
Chemicals	141	2,919	11,416	85,953	8,933,098	17,883,481	76,586,209	135,834,320	59,248,111
Clay products and non-clay refractories	42	578	4,868	17,126	1,501,751	6,588,314	4,505,684	18,427,668	13,921,984
Compressed and liquefied gases	16	209	404	6,049	462,910	723,318	908,124	4,748,841	3,840,717
Druggist preparations	70	582	1,344	1,439	1,801,271	1,518,012	5,390,921	15,946,213	10,555,292
Dyeing and finishing textiles	292	3,226	25,058	25,058	10,862,737	32,937,737	52,733,674	126,556,752	73,823,078
Fertilizers	7	97	448	3,517	257,323	582,554	3,508,447	5,189,131	1,680,684
Fireworks	6	17	283	342	36,020	358,374	676,777	1,444,786	768,009
Glass	9	65	582	2,543	243,286	815,776	706,987	3,213,895	2,506,908
Glue and gelatin	12	39	151	861	142,824	224,593	2,062,205	3,112,620	1,050,415
Ice, manufactured	150	285	2,345	92,509	832,987	4,208,870	4,629,687	22,569,278	17,939,591
Ink, printing	50	412	1,069	8,529	1,891,787	1,875,611	8,230,738	19,172,925	10,942,187
Leather, tanned, curried and finished	55	350	2,906	11,220	1,644,787	4,457,168	19,549,712	30,342,378	10,792,666
Lubricating oils and greases not made in petroleum refineries	23	200	951	2,154	667,413	1,398,701	12,563,224	22,437,487	9,874,263
Oils, essential	6	27	83	319	111,427	143,898	1,684,513	2,228,153	543,640
Paints and varnish	206	2,851	7,667	38,758	9,397,152	11,887,246	91,799,481	150,428,988	58,629,507
Paper	21	182	1,744	28,821	689,624	2,808,663	8,340,713	14,746,345	6,405,632
Paving materials, asphalt, tar, etc.	5	75	173	1,478	268,241	318,223	469,401	1,663,930	1,194,529
Perfumes, toilet preparations	299	3,101	7,045	6,186	8,237,191	7,842,319	31,757,672	111,446,871	79,689,199
Pottery	12	110	765	2,262	358,817	1,172,816	459,796	3,065,963	2,606,167
Soap	43	1,490	3,844	16,292	3,433,237	5,429,799	45,731,703	79,978,151	34,246,448
Tanning materials	28	214	650	4,777	995,139	1,160,964	8,650,469	13,879,943	5,229,474
Wall paper	9	145	875	2,245	451,808	1,004,163	1,697,345	4,317,141	2,619,796
Wood preserving	4	38	301	1,201	87,979	345,080	3,498,889	4,262,798	763,909

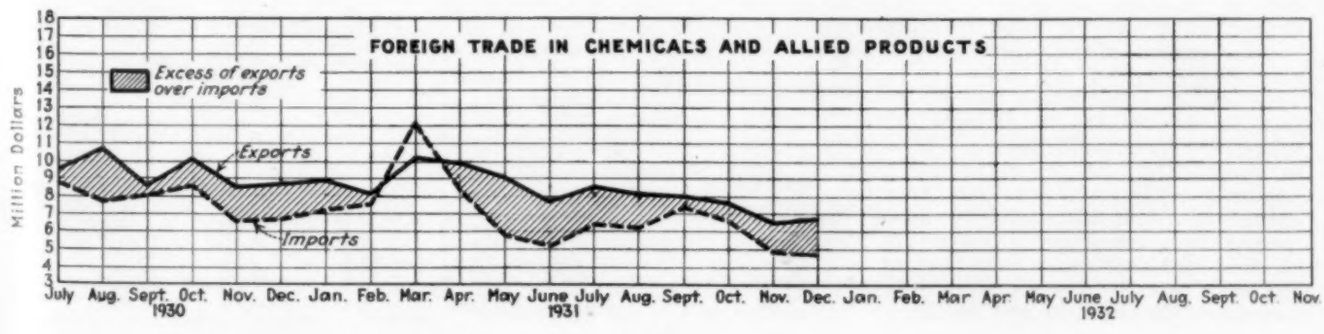
As defined by the Bureau of the Census, the New York City Industrial Area comprises six counties in New York—Bronx, Kings, New York, Queens, Richmond, Westchester — and six counties in New Jersey — Bergen, Essex, Hudson, Middlesex, Passaic, Union.

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



Based on electrical power cosumption, data supplied by Electrical World




Million Dollars
FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS
Excess of exports over imports
Exports
Imports
July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov.
1930
1931
1932

MARKET CONDITIONS AND PRICE TRENDS

Nitrogen Developments Feature Trading in Chemicals

Export Sales of Nitrate of Soda Attract Attention

WHILE activities in the general market were of a routine character, considerable interest was aroused in reports coming from Paris to the effect that the French Government had entered into a contract with the Allied Chemical & Dye Corp. for 25,000 tons of nitrate. The price was rumored to be the same as that at which the German Nitrate Cartel recently agreed to supply France. This price was reported at the rate of 830 francs a ton to the Comptoir de L'Azote, which is to resell to French agriculturalists at 950 francs a ton. Rumors also have been current in the domestic trade that Russia has been buying nitrates in this country and that a large export shipment was made to Russia in the last few days.

A cable to the Department of Commerce announced that 48,000 tons of Chilean nitrate of soda may be imported duty-free into Germany during the period ending June 30, 1932. Following an increase of German import duties and the subsequent import restriction on Chilean nitrate last July and August, respectively, the general most-favored nation treaty which had existed between Germany and Chile was abrogated. In October, Germany granted Chile duty-free importation of nitrate in such quantity, as to bring 1931 importations up to the total imported in 1930. The present agreement practically keeps the treaty operative for the first half of this year, with nothing said about further prolongation.

THAT progress in chemical manufacture is going ahead is evidenced by reports that Monsanto Chemical Works has begun commercial production of tricresyl phosphate for the lacquer trade and the same company has just announced the production of a new accelerator for the rubber trade. The DuPont organization reports increasing demand for its recently developed finish and will build a new plant in Philadelphia for its manufacture. Lancaster Processes, Inc., has been formed to manufacture and to issue licenses to manufacture a variety of chemical products made from asphalt and waste paper by a new process. The Continental Chemical Co. and the Texas Potash Co., both of Dallas, Texas, are planning to mine and refine potash in that state. The United States Potash Co. also is planning to build a potash refinery at Carlsbad, N. M. New production of borax on the Pacific Coast is said to be under way and rumors of keener competition for contract orders have been reaching the market, although open quotations are unchanged.

Imported sulphate of ammonia has continued to hold the market for that commodity in a weak position. The Pyroxylin Plastics Manufacturers' Association has filed a complaint against duty of 40c. per pound on imported pyroxylin. It is contended that the rate should be 60c. per pound. Incidentally, an interesting suit has arisen, brought by the government against surety on importations of synthetic phenolic resin, because of failure to re-deliver and export. This is an aftermath of the Bakelite case, which charged importers with patent infringement. The Bakelite charge was sustained and in consequence imports not only were prohibited but those already in the country had no legal entry and under the terms of the bonds, importers were obligated to ship the goods out of the country. In many cases, the resins had passed into consumption, and the present case will establish a precedent fixing the liability of numerous private and corporate surety.

This case has raised the question as to whether importers of sulphate of ammonia would find themselves in a similar predicament in the event of a ruling that recent importations constituted dumping. The investigation into sales values here and abroad is about completed.

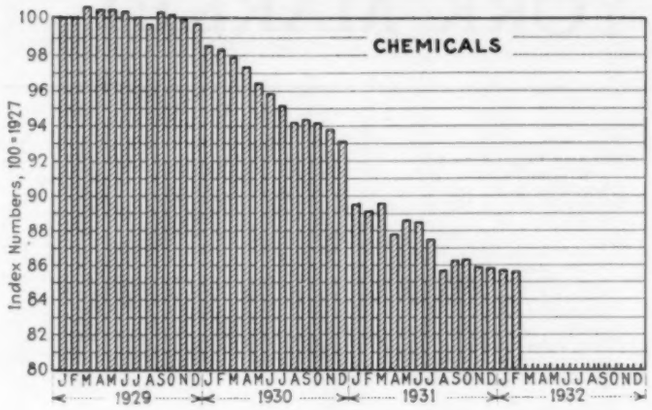
Uruguay Will Produce Copper Sulphate

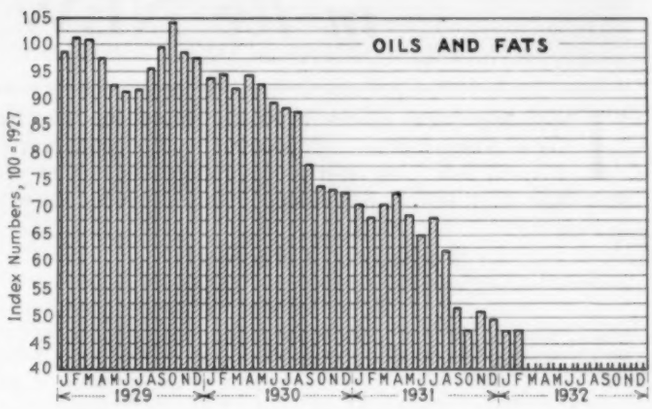
A consular report from Montevideo states that several months ago the National Administrative Council authorized the Institute of Industrial Chemistry to prepare a study on the possibilities of the state manufacturing copper sulphate. Uruguay has recently been consuming some 500 metric tons of this product, chiefly on account of the increased acreage of grapevines. At the last sitting of this body, of the bids of four foreign companies for the installation, the contract was awarded to the French firm of Rene Moritz de Chatou, for the sum of 518,475 francs. It is hoped to be in running order by the middle of 1932.

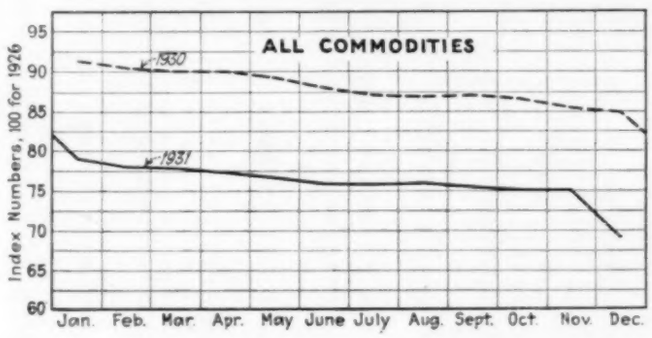
Factory Production and Consumption of Vegetable Oils

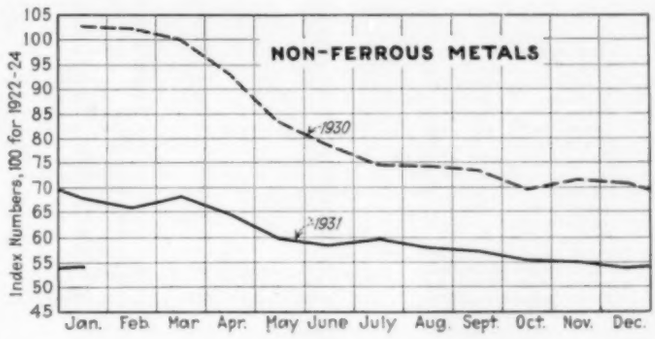
	Domestic Production			Domestic Consumption		
	1930	1931	Per Cent of	1930	1931	Per Cent of
Crude Oils	1,000 Lb.	1,000 Lb.	Change	1,000 Lb.	1,000 Lb.	Change
Cottonseed	1,616,102	1,417,226	— 12.3	1,602,064	1,404,081	—12.3
Peanut	25,495	13,730	— 46.1	24,044	12,188	—49.3
Coconut	352,727	303,434	— 13.9	632,907	557,548	—11.9
Corn	120,746	113,145	— 6.3	126,054	120,026	— 4.8
Soya bean	14,387	39,129	+171.9	17,599	35,501	+101.7
Olive, edible	2,184	1,638	— 25.0	2,443	2,000	— 18.1
Olive, inedible	.....	5	.....	6,459	7,485	+ 15.9
Sulphur oil	.....	.....	.....	40,125	39,627	— 1.3
Palm-Kernel	712	18,542	.....	54,031	55,140	+ 2.5
Rapeseed	.....	.....	.....	11,532	8,783	—23.8
Linseed	516,326	520,735	+ 0.85	351,335	297,494	—15.3
China wood	.....	.....	.....	87,092	82,393	— 5.4
Castor	46,856	49,912	+ 6.5	18,565	17,024	— 8.3
Palm	.....	.....	.....	219,993	243,325	+10.6
Sesame	.....	60,519	.....	.....	51,086	.....
Sunflower seed	.....	.....	.....	.....	20,607	.....
Other	23,717	1,768	.....	28,921	5,648	.....
	2,719,252	2,539,783	— 6.7	3,223,163	2,959,957	— 8.2
Refined Oils						
Cottonseed	1,457,564	1,292,767	— 11.3	1,241,983	1,048,696	—15.6
Peanut	18,946	10,658	— 43.7	17,567	12,045	—31.4
Coconut	300,405	272,471	— 9.3	329,637	310,363	— 5.9
Corn	101,148	104,014	+ 2.8	20,821	27,333	+31.2
Soya bean	6,629	23,890	+260.4	8,930	16,302	+82.5
Palm-Kernel	32,151	25,150	— 21.8	29,510	24,259	—17.8
Total refined oils	1,916,843	1,728,950	— 9.8	1,648,448	1,438,998	—12.7

CHEM. & MET. *Weighted Indexes of* PRICES









Prices for Chemicals Appear to Be On Steady Basis

WITH a large part of contract placements for important chemicals accounted for, the market seems to have passed through its keenest competitive period without any extensive price cutting. Readjustments in values which have been in progress over an extended period appear to have reached a point where they may be called stabilized. The steady introduction of new products is a factor which insures fluctuations in individual commodities or groups and commercial realization of low-cost production methods and processes cannot be disregarded in a discussion of price movements, but in general there is nothing now apparent which would indicate any price trend for the chemical market in general.

The weighted index number for chemicals receded slightly in the last month but this was largely due to a lowering in the solvents group, because of the decline in price for spirits of turpentine. Turpentine values are affected by conditions existing in the naval stores trade which have no connection with the general chemical industry. All grades of acetate of lead were reduced in price during the month, but this followed the course of the metal market and emphasized the fact that price changes may be expected whenever production costs warrant.

Considerable interest has been shown in the probable price trend for chemicals which find a wide outlet in the fertilizer trade. It is freely admitted that production and consumption of mixed fertilizer will be on a relatively low scale in the present year. Hence the possibility of later accumulations of raw materials is regarded in some quarters as a possible disturbing price factor but the stability of the entire chemical market is dependent on the maintenance of a fairly even position between supply and demand.

The position of the fertilizer trade also is referred to as a threat to values for sulphuric acid. The fact that prices for acid were unstable in Southern localities was regarded as a possibility for widening the area in which price-cutting competition would figure. Production of byproduct acid, however, was curtailed in the latter part of last year and there has been no evidence of increased selling pressure in the acid market.

The situation in China has caused some doubts about the movement of wood oil along the Yangste River to Hankow and prices in domestic markets have risen as a result. Oils and fats in general did nothing during the month to better their position and low prices seem assured for some time to come.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**85.70**
Last month	85.77
February, 1931	89.16
February, 1930	98.32

Price changes in the chemical market were not important during the month. Acetate of lead was marked down and spirits of turpentine failed to hold the price levels of a month ago. The weighted number declined slightly.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	**47.47**
Last month	47.33
February, 1931	67.92
February, 1930	94.68

China wood oil was higher on conditions prevailing in primary markets. Linseed oil was lower, with very little change in the position of animal fats. The weighted number moved upward following stronger markets for some of the oils.

CURRENT PRICES *in the* NEW YORK MARKET

THE following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Feb. 11.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.10 -$0.11	$0.10 -$0.11	$0.10.-$0.11
Acid, acetic, 28%, bbl., cwt.	2.40 - 2.65	2.40 - 2.65	2.60 - 2.85
Glacial 99%, tanks	8.10 -	8.10 -	8.98 -
drs	8.35 - 8.60	8.35 - 8.60	9.23 - 9.48
U. S. P. reagent, c'bys.	8.85 - 9.10	8.85 - 9.10	9.73 - 9.98
Boric, bbl., lb.	.06½- .07	.06½- .07	.06½- .07
Citric, kegs, lb.	.33½- .35	.33½- .35	.40 - .41
Formic, bbl., lb.	.10 - .11	.10 - .11	.10 - .11
Gallic, tech., bbl., lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb., lb.	.06 - .07	.06 - .07	.06 - .07
Lactic, 44%, tech., light, bbl., lb.	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic 18° tanks, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05¼	.05 - .05¼	.05 - .05¼
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -	18.50 -20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .12
Phosphoric, tech., c'bys., lb.	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton	15.50 -	15.50 -	15.50 -
Tannic, tech., bbl., lb.	.23 - .35	.23 - .35	.25 - .35
Tartaric, powd., bbl., lb.	.25½- .26	.25½- .26	.31 - .33
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	2.33 -	2.33 -	2.63 - 2.71
Alcohol, Butyl, tanks, lb.	.143 -	.143 -	.15½-
Alcohol, Amyl	-	-	-
From Pentane, tanks, lb.	.203 -	.203 -	.236 -
Denatured, 188 proof			
No. 1 special dr., gal.	.34½-	.34½-	.39 -
No. 5, 188 proof, dr., gal.	.35½-	.35½-	.39 -
Alum, ammonia, lump, bbl., lb.	.03 - .04	.03½- .04	.03½- .04
Chrome, bbl., lb.	.04½- .05	.04½- .05	.05 - .05½
Potash, lump, bbl., lb.	.03 - .04	.03½- .04	.03 - .03½
Aluminum sulphate, com., bags, cwt.	1.25 - 1.40	1.25 - 1.40	1.40 - 1.45
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb.	.02½- .03	.02½- .03	.03 - .04
tanks, lb.	.02½- .02½	.02½- .02½	.02½- .02½
Ammonia, anhydrous, cyl., lb.	.15½- .15½	.15½- .15½	.15½-
tanks, lb.	.05½-	.05½-	.05½-
Ammonium carbonate, powd. tech., casks, lb.	.10½- .11	.10½- .11	.10½- .11
Sulphate, wks., cwt.	1.10 -	1.10 -	1.70 -
Amylacetate tech., tanks, lb., gal.	.16 -	.16 -	.222-
Antimony Oxide, bbl., lb.	.06½- .08	.06½- .08	.08½- .10
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs, lb.	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	58.00 -60.00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	63.00 -65.00
Nitrate, cask, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums, cwt.	1.75 - 2.00	1.75 - 2.00	2.00 - 2.10
Borax, grain, bags, ton	50.00 -57.00	50.00 -57.00	50.00 -57.00
Bromine, cs., lb.	.36 - .38	.36 - .38	.45 - .47
Calcium acetate, bags	2.00 -	2.00 -	2.00 -
Arsenate, dr., lb.	.06 - .07	.06 - .07	.07 - .08
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	18.00 -	18.00 -	20.00 -
flake, dr., wks., ton.	21.00 -	21.00 -	22.75 -
Phosphate, bbl., lb	.08 - .08½	.08 - .08½	.08 - .08½
Carbon bisulphide, drums, lb.	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb.	.06½- .07	.06½- .07	.06½- .07
Chlorine, liquid, tanks, wks., lb.	.01½-	.01½-	.01½-
Cylinders	.04 - .06	.04 - .06	.04 - .06
Cobalt oxide, cans, lb.	1.35 - 1.45	1.35 - 1.45	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton.	13.00 -14.00	13.00 -14.00	13.00 -14.00
Copper carbonate, bbl., lb.	.07 - .16	.07 - .16	.08½- .18
Cyanide, tech., bbl., lb.	.39 - .44	.39 - .44	.41 - .46
Sulphate, bbl., cwt.	3.10 - 3.25	3.10 - 3.25	4.00 - 4.25
Cream of tartar, bbl., lb.	.19½- .19½	.20½- .22	.23½- .24
Diethylene glycol, dr., lb.	.14 - .16	.14 - .16	.14 - .16
Epsom salt, dom., tech., bbl., cwt.	1.70 - 2.00	1.70 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt.	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb.	.10 -	.10 -	.085-
Formaldehyde, 40%, bbl., lb.	.06 - .07	.06 - .07	.06 - .07
Furfural, dr., contract, lb.	.10 - .15	.10 - .12	.10 - .12
Fusel oil, crude, drums, gal.	1.10 - 1.20	1.10 - 1.20	1.30 - 1.40
Refined, dr., gal.	1.80 - 1.90	1.80 - 1.90	1.90 - 2.00
Glaubers salt, bags, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Glycerine, c.p., drums, extra, lb.	.11½- .11¾	.11½- .11¾	.12½- .13
Lead:			
White, basic carbonate, dry casks, lb.	.06½-	.06½-	.07½-
White, basic sulphate, sck., lb.	.06 -	.06 -	.07 -
Red, dry, sck., lb.	.06½-	.06½-	.08 -
Lead acetate, white crys., bbl., lb.	.10½- .11	.11 - .12	.11 - .12
Lead arsenate, powd., bbl., lb.	.10 - .14	.10 - .14	.13 - .14
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk, lb.	.05½-	.05½-	.07 -
Lithophone, bags, lb.	.04½- .05	.04½- .05	.04½- .05
Magnesium carb., tech., bags, lb.	.05½- .06	.06 - .06½	.06 - .06½
Methanol, 95%, tanks, gal.	.33 -	.33 -	.38 -
97%, tanks, gal.	.34 -	.34 -	.39 -
Synthetic, tanks, gal.	.35½-	.35½-	.40½-
Nickel salt, double, bbl., lb.	.10½- .11	.10½- .11	.10½- .11
Single, bbl., lb.	.10½- .11	.10½- .11	.10½- .11
Orange mineral, csk., lb.	.09½-	.09½-	.10 -
Phosphorus, red, cases, lb.	.42 - .44	.42 - .44	.42 - .44
Yellow, cases, lb.	.31 - .32	.31 - .32	.31 - .32
Potassium bichromate, casks, lb.	.08 - .08½	.08½- .09	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05 - .05½	.05 - .05½	.05½- .06
Chlorate, powd., lb.	.08 - .08½	.08 - .08½	.08 - .08½
Cyanide, cs., lb.	.55 - .57	.55 - .57	.55 - .57
First sorts, csk., lb.	.08½- .09	.08½- .09	.08½- .09
Hydroxide (c'stic potash) dr., lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Muriate, 80% bgs., ton	37.15 -	37.15 -	37.15 -
Nitrate, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.16 - .16½
Prussiate, yellow, casks, lb.	.18½- .19½	.18½- .19	.18½- .19
Sal ammoniac, white, casks, lb.	.04½- .05	.04½- .05	.04?- .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	16.00 -18.00	16.00 -18.00	15.00 -18.00
Soda ash, light, 58%, bags, contract, cwt.	1.15 -	1.15 -	1.15 -
Dense, bags, cwt.	1.17½-	1.17½-	1.17½-
Soda, caustic, 76%, solid, drums, contract, cwt.	2.50 - 2.75	2.50 - 2.75	2.50 - 2.75
Acetate, works, bbl., lb.	.05 - .06	.05 - .06	.04½- .05
Bicarbonate, bbl., cwt.	1.85 - 2.00	1.85 - 2.00	2.00 - 2.25
Bichromate, casks, lb.	.05 - .06	.05 - .06	.07 - .07½
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chlorate, kegs, lb.	.05½- .07½	.05½- .07½	.05½- .07½
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.00
Cyanide, cases, dom., lb.	.15½- .16	.15½- .16	.17 - .18
Fluoride, bbl., lb.	.07½- .08	.07½- .08	.08 - .09
Hyposulphite, bbl., lb.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Nitrate, bags, cwt.	1.77 -	1.77 -	2.07 -
Nitrite, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.0265 - .03	.0265 - .03	.02½- .03
Prussiate, yel. drums, lb.	.11½- .12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt.	.60 - .70	.60 - .70	.60 - .70
Sulphide, fused, 60-62%, dr., lb.	.02½- .03½	.02½- .03	.02½- .03
Sulphite, cyrs., bbl., lb.	.03 - .03½	.03 - .03½	.03 - .03½
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 -
Chloride, dr., lb.	.05 - .06	.05 - .06	.05 - .06
Dioxide, cyl., lb.	.06½- .07	.06½- .07	.06½- .07
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	nom.-	nom.-	nom.-
Oxide, bbl., lb.	.24½-	.24½-	.27½-
Crystals, bbl., lb.	.23½-	.23½-	.25 -
Zinc chloride, gran., bbl., lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Carbonate, bbl., lb.	.10½- .11	.10½- .11	.10½- .11
Cyanide, dr., lb.	.41 - .42	.41 - .42	.41 - .42
Dust, bbl., lb.	.05½- .06	.05½- .06	.06 - .07
Zinc oxide, lead free, bag, lb.	.06½-	.06½-	.06½-
5% lead sulphate, bags, lb.	.06½-	.06½-	.06½-
Sulphate, bbl., cwt.	3.00 - 3.25	3.00 - 3.25	3.00 - 3.25

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.09½-$0.10½	$0.09½-$0.10	$0.10½-$0.11
Chinawood oil, bbl., lb.	.07½-	.07½-	.07 -
Coconut oil, Ceylon, tanks, N. Y. lb.	.03½-	.03½-	.04½-
Corn oil crude, tanks, (f.o.b. mill), lb.	.03½-	.03½-	.07½-
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.03½-	.03½-	.06½-
Linseed oil, raw, car lots, bbl., lb.	.064-	.067-	.088-
Palm, Lagos, casks, lb.	.04 -	.04½-	.06½-
Niger, casks, lb.	.03½-	.03½-	.06½-
Palm Kernel, bbl., lb.	.05½-	.05½-	.05½-
Peanut oil, crude, tanks (mill), lb.	.03¼-	.03¼-	.07 -
Rapeseed oil, refined, bbl., gal.	.39 - .41	.39 - .41	.54 - .56
Soya bean, tank (f.o.b. Coast), lb	nom.-	nom.-	.08 -
Sulphur (olive foots), bbl., lb.	.04½-	.04½-	.06½-
Cod, Newfoundland, bbl., gal.	.25 - .27	.25 - .27	.42 - .45
Menhaden, light pressed, bbl., gal.	.33 - .34	.33 - .34	.34 - .36
Crude, tanks (f.o.b. factory), gal.	.20 -	.20 -	.20 -
Whale, crude, tanks, gal.	nom.-	nom.-	.78
Grease, yellow, loose, lb.	.02½-	.02½-	.02½-
Oleo stearine, lb.	.04½-	.05½-	.07½-
Red oil, distilled, d.p. bbl., lb.	.07½-	.07½-	.08½-
Tallow, extra, loose, lb.	.02½-	.02½-	.03½-

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.14½- .15	.14½- .15	.15 - .16
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .52

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	$1.10 –$1.25	$1.10 –$1.25	$1.10 –$1.25
Benzidine base, bbl., lb.	.65 – .67	.65 – .67	.65 – .67
Benzoic acid, U.S.P., kgs, lb.	.48 – .52	.48 – .52	.57 – .60
Benzyl chloride, tech., dr., lb.	.30 – .35	.30 – .35	.30 – .35
Benzol, 90%, tanks, works, gal.	.20 – .21	.20 – .21	.20 – .21
Beta-naphthol, tech., drums, lb.	.22 – .24	.22 – .24	.22 – .24
Cresol, U. S. P., dr., lb.	.10½– .11	.12½– .14	.14 – .17
Cresylic acid, 97%, dr., wks., gal.	.49 – .52	.54 – .58	.58 – .61
Diethylaniline, dr., lb.	.55 – .58	.55 – .58	.55 – .58
Dinitrophenol, bbl., lb.	.29 – .30	.29 – .30	.29 – .30
Dinitrotoluen, bbl. lb.	.16 – .17	.16 – .17	.16 – .17
Dip oil 25% dr., gal.	.23 – .25	.23 – .25	.26 – .28
Diphenylamine, bbl., lb.	.38 – .40	.38 – .40	.38 – .40
H-acid, bbl., lb.	.65 – .70	.65 – .70	.68 – .70
Naphthalene, flake, bbl., lb.	.03½– .04½	.03½– .04½	.03½– .04½
Nitrobenzene, dr., lb.	.08½– .09	.08½– .09	.08½– .10
Para-nitraniline, bbl., lb.	.51 – .55	.51 – .55	.51 – .55
Para-nitrotoluine, bbl., lb.	.26 – .28	.29 – .31	.29 – .31
Phenol, U.S.P., druma, lb.	.14½– .15	.14½– .15	.14½– .15
Picric acid, bbl., lb.	.30 – .40	.30 – .40	.30 – .40
Pyridine, dr., lb.	1.50 – 1.75	1.50 – 1.80	1.50 – 1.80
R-salt, bbl., lb.	.40 – .44	.40 – .44	.40 – .44
Resorcinal, tech., kegs, lb.	.65 – .70	.70 – .80	1.15 – 1.25
Salicylic acid, tech., bbl., lb.	.33 – .35	.33 – .35	.33 – .35
Solvent naphtha, w.w., tanks, gal.	.26 –.....	.26 –.....	.25 – .30
Tolidine, bbl., lb.	.86 – .88	.86 – .88	.88 – .90
Toluene, tanks, works, gal.	.30 –.....	.30 –.....	.30 –.....
Xylene, com., tanks, gal.	.26 –.....	.26 –.....	.25 – .28

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00–$25.00	$23.00–$25.00	$23.00–$25.00
Casein, tech., bbl., lb.	.07½– .14	.07½– .14	.08½– .11½
China clay, dom., f.o.b. mine, ton	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.03 – .20	.03 – .20	.03½– .20
Prussian blue, bbl., lb.	.35 – .36	.35 – .36	.35 – .36
Ultramine blue, bbl., lb.	.06 – .32	.06 – .32	.06 – .32
Chrome green, bbl., lb.	.27 – .28	.27 – .28	.27 – .30
Carmine red, tins, lb.	5.25 – 5.40	5.00 – 5.40	6.00 – 6.50
Para toner, lb.	.75 – .80	.75 – .80	.77 – .80
Vermilion, English, bbl., lb.	1.45 – 1.50	1.55 – 1.60	1.75 – 1.90
Chrome yellow, C. P., bbl., lb.	.16 – .16½	.16½– .17	.16½– .17
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 – .08½	.07 – .08½	.07 – .08½
Gum copal Congo, bags, lb.	.06 – .08	.06 – .08	.07 – .09
Manila, bags, lb.	.16 – .17	.16 – .17	.16 – .17
Damar, Batavia, cases, lb.	.16 – .16½	.16 – .19	.16 – .16½
Kauri No. 1 cases, lb.	.45 – .48	.45 – .48	.48 – .53
Kieselguhr (f.o.b. N.Y.), ton	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton	40.00 –.....	40.00 –.....	40.00 –.....
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	.03 – .40	.03 – .40	.03 – .35
Rosin, H., bbl.	3.80 –.....	3.95 –.....	5.75 –.....
Turpentine, gal.	38½–.....	39½–.....	.46 –.....
Shellac, orange, fine, bags, lb.	.32 – .34	.37 – .38	.41 – .42
Bleached, bonedry, bags, lb.	.24 – .26	.28 – .30	.28 – .30
T. N. bags, lb.	.12 – .13	.13 – .14	.17 – .18
Soapstone (f.o.b. Vt.), bags, ton	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc, 200 mesh (f.o.b. Vt.), ton	8.00 – 8.50	8.00 – 8.50	9.50 –.....
300 mesh (f.o.b. Ga.), ton	7.50 –10.00	7.50 –10.00	7.50 –11.00
225 mesh (f.o.b. N. Y.), ton	13.75 –.....	13.75 –.....	13.75 –.....

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	$0.16 –$0.20	$0.16 – $0.20	$0.21 –$0.23
Beeswax, ref., light, lb.	.25 – .27	.25 – .27	.29 – .30
Candelilla, bags, lb.	.14 –.....	.14½–	.14 – .15
Carnuba, No. 1, bags, lb.	.23 – .24	.27 – .28	.22 – .24
Paraffine, crude			
105-110 m.p., lb.	.03½– .03¾	.03½– .04¼	.03½– .03¾

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton	$200.00–.....	$200.00–.....	$200.00–.....
Ferromanganese, 78-82%, ton	80.00–85.00	80.00–85.00	80.00–85.00
Ferrochrome, 65-70%	.11–.....	.11–.....	.....–.....
Spiegeleisen, 19-21% ton	30.00–.....	30.00–.....	30.00–.....
Ferrosilicon, 14-17%, ton	31.00–.....	31.00–.....	39.00–.....
Ferrotungsten, 70-80% lb.	1.00– 1.10	1.00– 1.10	1.10–.....
Ferrovanadium, 30-40%, lb.	3.15– 3.50	3.15– 3.50	3.15– 3.50

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0.06 –.....	$0.07½–.....	$0.10½–.....
Aluminum, 96-99%, lb.	.233–.....	.233–.....	.233–.....
Antimony, Chin. and Jap., lb.	.06½–.....	.06½–.....	.075–.....
Nickel, 99%, lb.	.35 –.....	.35 –.....	.35 –.....
Monel metal blocks, lb.	.28 –.....	.28 –.....	.28 –.....
Tin, 5-ton lots, Straits, lb.	.20½–.....	.20½–.....	.26½–.....
Lead, New York, spot, lb.	.0375–.....	.0375–.....	.045–.....
Zinc, New York, spot, lb.	.0345–.....	.0345–.....	.0437–.....
Silver, commercial, oz.	.30 –.....	.30 –.....	.0294–.....
Cadmium, lb.	.55 –.....	.55 –.....	.70 –.....
Bismuth, ton lots, lb.	1.50 –.....	1.50 –.....	1.25 –.....
Cobalt, lb.	2.50 –.....	2.50 –.....	2.50 –.....
Magnesium, ingots, 99%, lb.	.30 –.....	.30 –.....	.48 –.....
Platinum, ref., oz.	40.00 –.....	40.00 –.....	36.00–.....
Palladium, ref., oz.	19.00 – 21.00	19.00 – 21.00	19.00– 21.00
Mercury, flask, 75 lb.	65.00 – 66.00	65.00 – 66.00	103.00–.....
Tungsten powder, lb.	1.45 –.....	1.45 –.....	1.65–.....

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton	$6.50 –$8.25	$6.50 –$8.25	$6.50 –$8.25
Chrome ore, c. f , post, ton	17.00 –20.00	17.00 –20.00	19.50 –24.00
Coke, fdry., f.o b. ovens, ton	2.75 – 2.85	2.75 – 3.85	2.75 – 2.85
Fluorspar, gravel, f.o.b. Il., ton	17.25 –20.00	17.25 –20.00	17.25 –20.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit	.25 – .26	.25 – .26	.27 – .28
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	.45 –.....	.45 –.....	.35 – .40
Monazite, 6% of ThO_2, ton	60.00 –.....	60.00 –.....	60.00 –.....
Pyrites, Span. fines, c.i.f., unit	.13 –.....	.13 –.....	.13 –.....
Rutile, 94-96% TiO_2, lb.	.10 – .11	.10 – .11	.10 – .11
Tungsten, scheelite, 60% WO_3 and over, unit	10.50 –12.00	10.50 –12.00	12.00 –12.50

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

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Battery Plant Addition—Willard Storage Battery Co., 5700 East 9th St., Los Angeles, Calif., awarded contract for addition to battery plant including erection of a lead oxide mill, acid-reclaiming plant and enlargement of administration building to William P. Neil Co., 4814 Vista St., Los Angeles. Estimated cost $100,000.

Benzol Recovery Plant—Municipality c/o City Clerk, Budapest, Hungary, wants tenders for erection and supply of a complete benzol recovery plant at gas works.

Briquette Plant—Philadelphia & Reading Coal & Iron Co., Reading Terminal, Philadelphia, Pa., plans to rebuild experimental briquette plant at Landingville destroyed by fire.

Plant—Kinloch Brass Casting Co., 2356 Palm St., St. Louis, Mo., awarded contract for construction of a 1 story, 50 x 70 ft. factory to C. L. Williams Realty Co., 518 South Vandeventer St., St. Louis.

Brick Plant—M. Lanz, 2907 Carson St., Pittsburgh, Pa., will soon receive bids for a 1 story, 40 x 60 ft. brick plant at Jane and 34th Sts. Geisler & Smithyman, 335 Boulevard Allies, Pittsburgh, are architects.

Cosmetic Manufacturing Plant—Owner, c/o Ponds Extract Co., 131 Hudson St., New York, N. Y., and London, England, will build a cosmetic manufacturing, 25,000 sq.ft. at London. Estimated cost to exceed $40,000. Work will be done by general and separate contracts.

Drug Factory—McKesson-Roanoke Drug Corp., Roanoke, Va., awarded contract for construction of a warehouse to J. F. Barbour & Sons, Roanoke. Estimated cost $60,000.

Plant—Zonite Products Co., 405 Lexington Ave., New York, N. Y., awarded contract for construction of a plant for the manufacture of drugs and patent medicines at Ste Therese, Que., to J. Gillets & Co., 4392 City Hall, Montreal.

Dye Plant—Apex Piece Dyeing Co., 155 Sherman Ave., Paterson, N. J., will soon award contract for a 2 and 3 story dye plant. Estimated cost $40,000. John C. Van Vlandren, 140 Market St., Paterson, is architect.

Fertilizer Building—Department of Sanitation, Municipal Bldg., New York, N. Y., having sketches made for construction of a 2 story, 81 x 193 ft. fertilizer building, and 4 story, 84 x 118 ft. storage building in connection with sewage disposal plant at Wards Island. Estimated total cost $550,000. Sloan & Robertson, 420 Lexington Ave., New York, are architects.

Plant—Flintkote Co., Maple St., East Rutherford, N. J., awarded contract for construction of a plant to Ferber Construction Co., 16 Johnson St., Hackensack. Estimated cost $40,000.

Flotation Mill—Bellboy Gold Mining Co., Moscow, Idaho, having preliminary plans prepared for construction of a 200-ton flotation mill. M. J. Savage, Kellogg, is president.

Flotation Mill—Westener Gold-Lead Mines Co., E. L. Tomlinson, Pres. and Mgr., Venezia, Ariz., having plans prepared for construction of a 1,000 ton flotation mill, including installation of 350 hp. Diesel engine and four air compressor plants.

Gas Cell Shop—Bureau of Yards & Docks, Navy Dpt., Washington, D. C., awarded contract for a 1 story gas cell shop and storage building at Naval Air Station, Lakehurst, N. J., to H. J. Roman Co., 18th and Cherry Sts., Philadelphia, Pa. Estimated cost $200,000.

Gas Plant—Birmingham Gas Co., 317 North 20th St., Birmingham, Ala., subsidiary of A. E. Fitkin & Co., Ltd., 39 Broadway, New York, N. Y., plans gas plant improvements and line extensions at Birmingham. Estimated cost to exceed $150,000.

Gas Plant—Clark & Jacoby, Kansas City, Mo., Engrs., conducting surveys to determine size and location of gas plant to be constructed at Marion, Ia., for City of Marion.

Gas Plant—City of El Dorado, Kan., E. W. Grant, City Comr., completed plans for construction of intermediate pressure type gas plant and distribution system. Estimated cost $226,000. Burns & McDonnell Engineering Co., 406 Interstate Bldg., Kansas City, Mo., is engineer.

Gas Plant — City of Oswego, Kan., having plans and specifications made for construction of a municipal gas plant and distribution system. Estimated cost $32,000. Emporia Engineering Co., Emporia, is engineer. Elmer S. Nance is city clerk.

Gas Plant—Jacksonville Gas Co., Jacksonville, Fla., subsidiary of A. E. Fitkin & Co., Ltd., 39 Broadway, New York, N. Y., plans gas plant improvements and line extensions at Jacksonville. Estimated cost to exceed $150,000.

Gas Plant—New York & Richmond Gas Co., 691 Bay St., St. George, S. I., N. Y., preliminary plans prepared for construction of a 1 story artificial gas plant at Honeywood. Estimated cost $125,000. Private plans. Maturity about July.

Gypsum Plant—Jumbo Plaster & Cement Co., Siguard, Utah, plans to rebuild plant destroyed by fire. Estimated cost $250,000.

Chemistry Building—Trinity College, 115 Vernon St., Hartford, Conn., completed preliminary plans for construction of a chemistry building. Estimated cost $150,000. McKim, Mead & White, 101 Park Ave., New York, are architects. Maturity fall or later.

Laboratory—College of Forestry, Syracuse, N. Y., awarded contract for construction of a laboratory building to William J. Murray, 41 South Pearl St., Albany, $36,990.

Laboratory—Columbia University, Joseph W. Barker, Dean of Engineering, 116th St. and Broadway, New York, N. Y., having tentative plans prepared for construction of an engineering school, shop and laboratory center. Estimated cost approximately $20,000,000. Committee on site, endowment, etc., appointed.

Laboratory (Engineering) — International Business Machine Corp., T. J. Watson, Pres., North Endicott St., Binghamton, N. Y., plans construction of a new engineering laboratory.

Laboratories—John Carroll University, H. R. Neff, Chn. of Bldg. Comm., Marshall Bldg., Cleveland, O., plans construction of a group of buildings including physics, biology and chemistry laboratories, etc., at Miramer Blvd. Estimated cost $4,000,000. Philip L. Small, Inc., Terminal Tower, Cleveland, are architects. George S. Rider Co., Marshall Bldg., Cleveland, are engineers.

Laboratories—Denison University, Granville, O., plans construction of a group of buildings including biology building, laboratory, etc. Gehron & Ross, 101 Park Ave., New York, N. Y., are architects.

Laboratory—Department of Hospitals, Municipal Bldg., New York, N. Y., having plans prepared for a 3 story, 35 x 80 ft. laboratory, etc., at Metropolitan Hospital, Welfare Island. M. Bernstein, 2 Columbus Circle, New York, is architect.

Laboratories—Board of Regents, University of Texas, c/o J. W. Calhoun, Comptroller, Austin, Tex., awarded contract for construction of a group of buildings including engineering building to Bellows-McClay Construction Co., Construction Bldg., Dallas, geology building to Christy Dolph Construction Co., Construction Bldg., Dallas and physics building to P. O'B. Montgomery, Construction Bldg., Dallas. Estimated total cost $2,400,000.

Science Building—Department of Institutions & Agencies, State Office Bldg., Trenton, and Rutgers University, College Ave., New Brunswick, N. J., rejected bids for construction of 3 story, 70 x 145 ft. soil science building at State Experimental Farm, New Brunswick. $150,000. Alex Merchant, 1 Elm Row, New Brunswick, is architect.

Laboratories—Reported list of building programs for Colleges:

Va., Salem—Roanoke College, having plans prepared for science hall including laboratories.

O., Cincinnati — St. Xavier College, plans science hall and laboratory. Exceeds $150,000.

D. C., Washington — Georgetown University, plans construction of science buildings including laboratories. Estimated cost to exceed $1,000,000.

Conn., Hartford—Trinity College, having plans prepared for chemistry building including laboratory. Estimated cost to exceed $150,000.

N. Y., Allegany—Saint Bonoventure's College, plans construction of science hall, seminary and laboratory. Cost to exceed $150,000.

S. D., Huron—Huron College, having plans prepared for library, science hall and laboratory. Estimated cost to exceed $150,000.

N. C., Raleigh—Merideth College, plans replacing following temporary buildings, auditorium, gymnasium, science buildings with laboratory, etc.

Leather Factory—McGrath Leather Co., Butler St., Salem, Mass., plans reconstruction of 2 story warehouse destroyed by fire. Estimated cost $40,000. Private plans.

Lignite Deposits—Ural Coal Trust, Division of Soviet Government, c/o Amtorg Trading Corp., 261 5th Ave., New York, N. Y., plans opening and development of mines for lignite deposits. 3,000,000 ton annual production in southern Urals along Cheliahinsk-Troitzk railroad. Maturity 1932.

Magazine Buildings — Bureau of Yards & Docks, Navy Department, Washington, D. C., will receive bids until February 24 for magazine buildings including conveyor housings, conveyors, piping and equipment at Naval Mine Depot, Yorktown, Va.

Magazines—Constructing Quartermaster, Langley Field, Va., will receive bids until March 2 for construction of four magazines.

Paint and Hardware Factory—W. Hurwitz & Sons, 160th St. and Jamaica Ave., New York, N. Y., will receive bids about July 1 for construction of a 3 story manufacturing plant and storage building. Estimated cost to exceed $40,000. J. Fein, Brooklyn, is architect.

Paint Products Plant—E. I. duPont de Nemours & Co., duPont Bldg., Wilmington, Del., awarded contract for construction of a 5 story, 75 x 160 ft. plant for the manufacture of De Lux, a new paint product at 35th St. and Grays Ferry Ave., Philadelphia, Pa., to Austin Co., 16th and Filbert Sts., Philadelphia. Estimated cost $500,000.

Varnish Factory—Payson Varnish Co., 141st St. and Southern Blvd., New York, N. Y., plans construction of a 1 story, 49 x 95 ft. plant. A. Pirner, 2742 East Tremont Ave., New York, is architect.

Pulp and Paper Plant—Commercial Pulp & Paper Co., c/o C. A. Kieren, Beaumont, Tex., arranged to take over plant of Yellow Pine Paper Co., at Beaumont, and plans improvements consisting of new incinerators, disc evaporators, waxing machinery, etc., 10,500 tons of paper annual capacity. Estimated cost $125,000. Private plans.

Cotton Oil Mill—Forrest City Cotton Oil Mill, Phillip Hickey, Mgr., Forrest City, Ark., awarded contract for construction of four oil mill buildings including 90 x 200 ft. warehouse, 60 x 60 ft. cleaning room, two unloading sheds, each 18 x 100 ft. to John A. Moore, Forrest City and Muskogee Steel Co., Muskogee, Okla. Estimated cost $50,000.

Oil Treating Plant—Continental Oil Co., Fairfield, Md., awarded contract for construction of Stratford treating plant for gasoline, 4,000 bbl. daily capacity in connection with refinery to Aleo Products Co., 220 East 42nd St., New York, N. Y.

Refinery—French Government, awarded initial contract for design and construction of primary crude oil distillation equipment in connection with Normandy refinery at Le Harve on Transcarville Canal to Arthur G. McKee & Co., 2422 Euclid Ave., Cleveland, O., through its associate Schneider et Cie, Paris. $1,000,000. Estimated total cost $15,000,000.

Refinery—Pan American Petroleum & Transport Co., 122 East 42nd St., New York, N. Y., having plans prepared for construction of a new refinery including pumping plant, power house, storage building and distribution system, etc., in vicinity of Houston, Tex. Estimated cost to exceed $1,000,000. Maturity indefinite.

Refinery—Shell Petroleum Corp., Sterling Bldg., Houston, Tex., plans construction of refinery plant, additional stills and cracking unit at Deer Park. Estimated cost $250,000.

Refiners (Gasoline)—Arkansas Fuel Oil Co., c/o K. E. Jones, Shreveport, La., will build a gasoline refinery, 30,000 gal. capacity at Willow Springs, Tex., by day labor. Private plans.

Refinery (Oil)—La Porte Oil & Refining Co., Inc., c/o J. D. Wrather, et al, La Porte, Tex., have site under option for construction of an oil refinery. Estimated cost $100,000. Private plans. Plan to let contracts and start construction some time in February.

Refinery (Oil)—Simrall Refining Corp. of Canada, 814 Union Central Bldg., Cincinnati, O., awarded contract for construction of refinery for gasoline and fuel oils at Amherstburg, Ont., to Foster-Wheeler, Ltd., Canadian Pacific R.R. Bldg., Toronto, Ont. Estimated cost $200,000.

Refining Unit — Distillazione Italiana Combustibili, S. A., Mestre, Italy, awarded contract for design and construction of a pressure distillate re-run unit for refinery at Mestre near Venice to Arthur G. McKee & Co., 2422 Euclid St., Cleveland, O. Estimated cost to exceed $1,000,000.

Rubber Factory—Weldon Roberts Rubber Co., 18 Oliver St., Newark, N. J., awarded contract for a 2 story addition to rubber factory to Damon G. Douglas Co., 605 Broad St., Newark. Estimated cost $40,000.

Smelter Plant—J. Adler, Humboldt St. and Meserole Ave., Brooklyn, N. Y., plans to rebuild smelter plant destroyed by fire. Laspia & Samenfeld, 217 Havemeyer St., Brooklyn, are architects.

Soap Manufacturing Plant—Lever Bros., 164 Broadway, Boston, Mass., awarded contract for design and construction of extensions to coap manufacturing plant including glycerine refining units, power plant addition, etc., at Hammond, Ind., to Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass. Estimated cost $100,000.

Stone Crushing Plant—Department of Purchases & Construction, Capitol Bldg., Springfield, Ill., will receive bids until February 16 for construction of a stone crushing plant including electric hoist and accessories, hoist motor, control system, hopper and chutes, dust elevator, storage bins, gates and spouts, electric travel chain hoist, signal system, etc., at Joliet. C. Herrick Hammond, 160 North La Salle St., Chicago, is architect. Engineering Service Co., 605 North Michigan Ave., is engineer.

INDUSTRIAL NOTES

NEWTON DIE CASTING CORPORATION, New Haven, Conn., has been purchased from the National Lead Company by the Doehler Die Casting Company.

U. S. ELECTRICAL MFG. CO., Los Angeles, has appointed The Maintenance Company representatives at 449 West 42nd St., New York.

ALLOY METAL WIRE CO., Moore, Pa., has opened a factory branch office at 504 Produce Exchange Bldg., Chicago, under R. L. Howe.

FOOTE BROS. GEAR & MACHINE CO., Chicago, has appointed Franklin H. Fowler as president to succeed James F. Griswold, who resigned.

MUNDET CORK CORP., New York, has appointed the Pioneer Sand and Gravel Co., as representatives at Seattle, Wash.

ARTHUR A. JOHNSON CORP. has acquired the McRae Paint Products, Inc., and McEverlast, Inc., under the name of the Johnson-March Corp.

ALLIS-CHALMERS MFG. CO., has appointed L. W. Grothaus as general representative to succeed Clarence E. Searle, who has resigned.

R. FUESS, INC., manufacturer of instruments, has established an American office at 245 West 55th St., under L. Muscat.

BLAW-KNOX CO., Pittsburgh, has appointed M. I. Dorfan as manager of the dust collector division.

WORTHINGTON PUMP & MACHINERY CORP., Harrison, N. J., has made the following appointments: C. E. Wilson, vice-president in charge of industrial relations; Clarence E. Searle, vice-president in charge of sales; and Charles M. Barney, as secretary.

EDWARD VALVE & MFG. CO., East Chicago, Ind., is represented in New York by the Dunbar Engineering Co. at its new address at 21 West St., New York.

REPUBLIC STEEL CORP. has appointed J. F. Mehlhope on the force of the Chicago Steel Service Co., Chicago distributors.

TOLHURST MACHINE WORKS, INC., Troy, New York, has been purchased by the American Machine & Metals, Inc., but will retain its name as a subsidiary.

Technical Societies, Trade Associations, And Commercial Organizations

AGRICULTURAL, Insecticide and Fungicide Mfrs.' Assn. Sec., G. B. Heckel, 901 Cunard Bldg., Philadelphia, Pa.

Amer. Assn. for the Advancement of Science. Perm. Sec., Chas. F. Roos, Smithsonian Inst. Bldg., Washington, D. C.

Amer. Assn. of Cereal Chemists. Sec.-Treas., M. D. Mize, 833 Omaha Grain Exchange, Omaha, Neb.

Amer. Assn. of Engrs. Sec., M. E. McIver, 8 S. Michigan Blvd., Chicago, Ill.

Amer. Assn. of Textile Chemists & Colorists. Sec., Alex. Morrison, c/o American Woolen Co., Shawsheen Village, Andover, Mass.

Amer. Bakers' Assn. Pres., Henry Stude; Sec., Tom Smith, 1135 Fullerton Ave., Chicago, Ill.

Amer. Ceramic Society. Gen. Sec., Ross C. Purdy, 2525 N. High St., Columbus, Ohio.

Amer. Chemical Society. Sec., Dr. Charles L. Parsons, Mills Bldg., Washington, D. C.

Amer. Concrete Institute. Sec., Harvey Whipple, 641 New Center Bldg., Detroit, Mich.

Amer. Electro-Platers' Soc. Sec., H. A. Giltertson, 434 So. Wabash Ave., Chicago, Ill.

Amer. Engineering Council. Exec. Sec., L. W. Wallace, 744 Jackson Pl., Washington, D. C.

Amer. Foundrymen's Assn. Exec. Sec.-Treas., C. E. Hoyt, 222 W. Adams St., Chicago, Ill.

Amer. Gas Assn. Man. Dir., Alexander Forward, 420 Lexington Ave., New York.

Amer. Gear Mfrs.' Assn. Sec., T. W. Owen, 3608 Euclid Ave., Cleveland, Ohio.

Amer. Glassware Mfrs. Inc. Sec., John Kunzler, House Bldg., Pittsburgh, Pa.

Amer. Inst. of Baking. Dean, C. B. Morison, 1135 Fullerton Ave., Chicago, Ill.

Amer. Inst. of Chemical Engrs. Sec., F. J. LeMaistre, Bellevue Court Bldg., Phila., Pa.

Amer. Inst. of Chemists. Sec., Howard S. Neiman, 2110 Woolworth Bldg., New York.

Amer. Inst. of Consulting Engrs. Sec. and Treas., Philip W. Henry, 75 West St., New York.

Amer. Inst. of Electrical Engrs. Nat. Sec., F. L. Hutchinson, 33 W. 39th St., New York.

Amer. Inst. of Mining & Metallurgical Engrs. Sec., A. B. Parsons, 29 W. 39th St., New York.

Amer. Inst. of Refrigeration. Gen. Sec., J. F. Nickerson, 433 N. Waller Ave., Chicago, Ill.

Amer. Iron & Steel Institute. Sec., Howard H. Cook, 75 West St., New York.

Amer. Leather Chemists' Assn. Sec., H. C. Reed, 143 W. 20th St., New York.

Amer. Management Assn. Man. Dir., W. J. Donald, 20 Vesey St., New York.

Amer. Manganese Products' Assn. Pres., J. Carson Adkerson, Metropolitan Bank Bldg., Washington, D. C.

Amer. Mfrs.' Export Assn. Gen. Mgr., Francis T. Cole, 401 Broadway, New York.

Amer. Museum of Safety. Dir., Albert A. Hopkins, Office, 141 E. 29th St.; Museum, 120 E. 28th St., New York.

Amer. Oil Burner Assn. Exec. Sec., Harry F. Tapp, 342 Madison Ave., New York.

Amer. Oil Chemists' Society. Sec., J. C. P. Helm, 705 Tchoupitoulas St., New Orleans, La.

Amer. Paint & Varnish Mfrs.' Assn., Inc. Sec. Emeritus, G. B. Heckel, 901 Cunard Bldg., Philadelphia, Pa.; Gen. Mgr., George V. Horgan, 2201 New York Ave., N. W., Washington, D. C.; Director of Scientific Section, H. A. Gardner, 2201 New York Ave., N. W., Washington, D. C.

Amer. Paper & Pulp Assn. Sec., Charles W. Boyce; Dir. Cost Dept., Thomas J. Burke, 370 Lexington Ave., New York.

Amer. Petroleum Inst. Exec. Vice-Pres., W. R. Boyd, Jr.; Sec., Lacey Walker, 250 Park Ave., New York.

Amer. Physical Soc. Sec., W. L. Severinghaus, Columbus Univ., New York.

Amer. Pulp & Paper Mill Superintendents' Assn. Sec., R. L. Eminger, 54 N. Main St., Miamisburg, Ohio.

Amer. Refractories Institute. Sec., Dorothy A. Texter, 2218 Oliver Bldg., Pittsburgh, Pa.

Amer. Soc. for Steel Treating. Sec., W. H. Eisenman, 7016 Euclid Ave., Cleveland, Ohio.

This compilation of organizations in the chemical engineering and related fields has been confined to those of broad technical and commercial interest. Lists of more specialized organizations in the leading countries have been kept on file for possible inquiries. These, as well as additions or corrections, should be directed to the Editor, *Chemical & Metallurgical Engineering*, 330 West 42d St., New York City.

Amer. Soc. for Testing Materials. Sec.-Treas., C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Amer. Soc. of Bakery Engrs. Sec., Victor E. Marx, 1541 Birchwood Ave., Chicago, Ill.

Amer. Soc. of Civil Engrs. Sec., George T. Seabury, 33 W. 39th St., New York.

Amer. Soc. of Heating & Ventilating Engrs. Sec., A. V. Hutchinson, 51 Madison Ave., New York.

Amer. Soc. of Mechanical Engrs. Sec., Calvin W. Rice, 29 W. 39th St., New York.

Amer. Soc. of Refrigerating Engrs. Sec., David L. Fiske, 37 W. 39th St., New York.

Amer. Soc. of Safety Engrs. Sec., W. Dean Keefer, 20 N. Wacker Drive, Chicago, Ill.

Amer. Soda Pulp Export Assn. Exec. Officer, Gibson Paine, 230 Park Ave., New York.

Amer. Standards Association. Sec., P. G. Agnew, 29 W. 39th St., New York.

Amer. Welding Soc. Sec., Miss M. M. Kelly, 33 W. 39th St., New York.

Amer. Wood-Preservers' Assn. Sec., H. L. Dawson, 1427 Eye Street, N. W., Washington, D. C.

Amer. Zinc Inst., Inc. Sec., Julian D. Conover, 60 E. 42d Street, New York.

Asbestos Brake Lining Assn. Commissioner, W. J. Parker, 7 East 44th St., New York.

Asphalt Institute. Sec., A. M. Maxwell, 331 Second Ave., New York.

Associated Cooperage Industries of Amer. Sec. L. F. Horn, 2008 Railway Exchange Bldg., St. Louis, Mo.

Associated Tile Mfrs. Sec., H. L. Gaardsmoe, 420 Lexington Ave., New York.

Assn. of American Soap & Glycerine Producers, Inc. Mgr. R. C. Edlund, 45 E. 17th St., New York.

Assn. of British Chemical Mfrs. Gen.-Mgr. & Sec., J. Davidson Pratt, 166 Piccadilly, London, W. 1, England.

Assn. of Consulting Chemists and Chemical Engineers. Sec., Dr. Paul Mahler, 50 E. 41st St., New York.

Assn. of Official Agricultural Chemists. Sec., W. W. Skinner, Box 290 Pennsylvania Ave., Station, Washington, D. C.

BISCUIT & Cracker Mfrs.' Assn. Sec., R. T. Stokes, 233 Broadway, New York.

British Assn. for the Advancement of Science. Sec., O. J. R. Howarth, Burlington House, Piccadilly, London, W. 1, England.

British Cast Iron Research Assn. Dir. and Sec., J. G. Pearce, 24, St. Paul's Square, Birmingham, England.

British Non-Ferrous Metals Research Assn. Sec., Arthur F. Ridley, Regnart Bldg., Euston St., London, N. W. 1.

Bureau of Raw Materials for American Vegetable Oils & Fats Industries. Sec., John B. Gordon, 1251 National Press Bldg., Washington, D. C.

CANADIAN Engineering Standards Assn. Sec., B. Stuart McKenzie, Room 14, 46 Elgin St., Ottawa, Ont., Canada.

Canadian Inst. of Chemistry. Sec., L. E. Westman, 366 Adelaide St., W., Toronto 2, Ont., Canada.

Canadian Inst. of Mining & Metallurgy, Sec., E. J. Carlyle, 923 Drummond Bldg., Montreal, Canada.

Canadian Pulp & Paper Assn. Sec., A. E. Cadman, 3420 University St., Montreal, Que., Canada.

Canadian Society of Forest Engrs. Sec., A. H. Richardson, Parliament Buildings, Toronto 5, Ont., Canada.

Ceramic Society. Sec., Dr. J. W. Mellor, North Staffordshire Technical College, Stoke-on-Trent, England.

Cercle de la Chimie. Sec., René Dage, 54 Rue de Turbigo, Paris, France.

Chemical, Metallurgical & Mining Society of South Africa, Inc. Sec., H. A. G. Jeffreys, Kelvin House, 100 Fox St., Johannesburg, Transvaal, South Africa.

Chemists' Club. Sec., Robert T. Baldwin, 52 E. 41st St., New York.

Chilean Nitrate Educational Bureau. Pres., H. C. Brewer, 120 Bway., New York.

Chlorine Institute, Inc., The. Sec., Robert T. Baldwin, 30 E. 42d St., New York.

Clay Products Assn. Sec. and Consulting Engineer, George C. D. Lenth, 111 W. Washington St., Chicago, Ill.

Common Brick Mfrs.' Assn. of Amer. Sec., Ralph P. Stoddard, 2121 Guarantee Title Bldg., Cleveland, Ohio.

Compressed Air Society. Sec., C. H. Rohrbach, Room 1507, 90 West St., New York.

Compressed Gas Mfrs.' Assn. Sec.-Treas., Franklin R. Fetherston, 110 W. 40th St., New York.

Copper & Brass Research Assn. Man. Dir., H. Foster Bain; Sec., Bertram B. Caddle, Mgr., W. A. Willis, 25 Broadway, New York.

Corn Industries Research Foundation. Dir., H. E. Barnard, Director, 225 Wimmer Bldg., Indianapolis, Ind.

DEUTSCHE Bunsengesellschaft für angewandte physikalische Chemie. Seelze, bei Hanover Nr. 197.

Deutsche Chem. Ges. Sec., Dr. H. Jost, Sigismundstr. 4, Berlin, W. 10, Germany.

Deutscher Verband für die Material prüfungen in der Technik. Berlin NW. 7, Ingenieurhaus.

EDIBLE Gelatin Mfrs.' Research Society of America, Inc. Sec., H. B. Sweatt, 55 West 42d St., New York.

Electrochemical Soc. Sec., Dr. C. G. Fink, Columbia Univ., New York.

Empire Council of Mining & Metallurgical Institutions, Sec.-Gen., Chas. McDermid, Cleveland House, 225, City Road, London, E.C. 1, England.

Engineering Inst. of Canada. Sec., R. J. Durley, 2050 Mansfield St., Montreal, Que., Canada.

FARADAY Society. Sec., G. S. W. Marlow, 13 South Square, Gray's Inn, London, W. C. 1, England.

Franklin Inst. of the State of Pa. Sec., Howard McClenahan, 15 South 7th St., Philadelphia, Pa.

GAS Products Assn. Sec., Mary Redden, 250 E. Ontario St., Chicago, Ill.

Glass Container Assn. Sec., V. L. Hall, 19 W. 44th St., New York.

Glycerine Producers' Assn. Mgr., R. C. Edlund, 45 E. 17th St., New York.

Gypsum Assn. Sec., H. J. Schweim, 211 W. Wacker Drive, Chicago, Ill.

HAWAIIAN Sugar Planters' Assn. Director of Experiment Station, H. P. Agee, P. O. Box 411, Honolulu, Hawaii.

Hydraulic Society, The. Sec., C. H. Rohrbach, Room 1507, 90 West St., New York.

ILLUMINATING Engineering Society. Gen. Sec., E. H. Hobbie, 29 W. 39th St., New York.

Industrial Alcohol Institute, Inc. Exec. Sec., Dr. Lewis H. Marks, 420 Lexington Ave., New York.

Insecticide & Disinfectant Mfrs.' Assn., Inc. Sec., H. W. Cole, P. O. Box 428, Holbrook, Mass.

Institute of Amer. Meat Packers. Pres., Wm. Whitfield Woods, 506 S. Wabash Ave., Chicago, Ill.

Institute of Makers of Explosives. Sec., C. Stewart Comeaux, 103 Park Ave., New York.

Institute of Margarine Mfrs. Sec., Dr. J. S. Abbott, 1008 Munsey Bldg., Washington, D. C.

Institute of Metals. Sec. G. Shaw Scott, 36 Victoria St., Westminster, London, S. W. 1, England.

Institute of Radio Engineers. Sec., Harold P. Westman, 33 West 39th St., New York.

Institution of Chemical Engineers. Hon. Sec., H. W. Cremer, Abbey House, Westminster, London, S. W. 1, England.

Institution of Mining & Metallurgy, Sec., Charles McDermid, Cleveland House, 225 City Road, London, E. C. 1, England.

Institution of Petroleum Technologists. Sec., Commander R. E. Stokes-Rees, Aldine House, Bedford St., Strand, London, W. C. 2, England.

International Acetylene Assn. Sec., H. F. Reinhard, 30 E. 42d St., New York.

International Society of Leather Trades' Chemists. Hon. Gen. Sec., Dr. J. Gordon Parker, 17 Market St., London, S. E. 1, England.

Iron & Steel Institute. Sec., G. C. Lloyd, 28 Victoria St., London, S. W. 1, England.

Junior Institution of Engineers. Sec., Herbert G. Riddle, 39 Victoria St., Westminster, S. W. 1, England.

Lead Industries Assn. Sec., F. E. Wormser, 420 Lexington Ave., New York.

MANUFACTURING Chemists' Assn. of the U. S. Sec., W. N. Watson, 1121 Woodward Bldg., Washington, D. C.

Metric Assn. Sec., Howard Richards, Pottsville, Pa.

Mining & Metallurgical Soc. of Amer. Sec., Percy E. Barbour, 75 West St., New York.

NATIONAL Academy of Sciences. Home Sec., Dr. Fred E. Wright, 2101 Constitution Ave., Washington, D. C.

National Assn. of Cost Accountants. Sec., Stuart C. McLeod, 1790 Bway., New York.

National Assn. of Cotton Mfrs. Sec., Russell T. Fisher, 80 Federal St., Boston, Mass.

National Assn. of Finishers of Textile Fabrics. Sec., Geo. L. Sawyer, 40 Worth St., New York.

National Assn. of Flat Rolled Steel Mfrs. Sec., A. N. Flora, Terminal Tower Bldg., Cleveland, Ohio.

National Assn. of Glue Mfrs. Inc. Sec., H. B. Sweatt, 55 West 42d St., New York.

National Assn. of Importers of Hides & Skins, Inc. Exec. Sec., Eugenia R. Arnold, P. O. Box 497, City Hall Annex, New York.

National Assn. of Mfrs. Sec. J. Lewis Benton, 11 West 42d St., New York.

National Assn. of Mfrs. of Pressed & Blown Glassware. Sec., John Kunzler, House Bldg., Pittsburgh, Pa.

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